THE IRREGULARITIES OF THE TEETH

TALBOT

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OF

THE TEETH

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H W C Bodecker

IRREGULARITIES OF THE TEETH

AND

THEIR TREATMENT

BY

EUGENE S. TALBOT, M. S., D. D. S., M. D., LL.D.

Professor of Stomatology, Illinois Medical College, Honorary President of the Dental Section of the Tenth International Medical Congress, Berlin, 1890; Honorary President of the Dental Section of the Twelfth International Medical Congress, Moscow, 1897; Member of the Thirteenth International Medical Congress, Paris, 1900; Member of the Fourteenth International Medical Congress, Madrid, 1903; Honorary Secretary of the Pan-American Medical Congress, Washington, 1893; Honorary Secretary of Pan-American Medical Congress, Havana, Cuba, 1901; Member of the American Medical Association; Fellow of the Chicago Academy of Medicine; Member of the Chicago Pathological Society; Member of the Chicago Medical Society; Secretary of the Section on Stomatology of the American Medical Association; Member of the Chicago Academy of Sciences; Fellow American Academy of Dental Science, Boston; Honorary Member of the Odontologischen Gesellschaft, Berlin, Germany; Membre Honoraire de l'Association Generale des Dentistes de France; Honorary Member Sociedad Odontologia Espanola; Corresponding Member of the Dansk-Tandlægeforening; Author of "Irregularities of the Teeth and Their Treatment"; Author of "Chart of Typical Forms of Constitutional Irregularities of the Teeth"; Author of "Etiology of Osseous Deformities of the Head, Face, Jaws and Teeth"; Author of "Degeneracy; Its Causes, Signs, and Results"; Author of "Interstitial Gingivitis; or, So-called Pyorrhœa Alveolaris," Etc., Etc.

FIFTH EDITION

WITH 581 ILLUSTRATIONS

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To

DR. N. S. DAVIS

WHO BY THE FOUNDATION OF THE AMERICAN MEDICAL ASSOCIATION HAS ELEVATED THE STATUS OF DENTISTRY AND ALL THE MEDICAL SCIENCES, THIS WORK IS

Respectfully Dedicated

PREFACE TO FIFTH EDITION.

Since the fourth edition of this work appeared, practically no modifications of the general principles therein outlined have been made. The laws by which deformities of the jaws and irregularities of the teeth are governed had been worked out on broad scientific lines, and hence made due allowance for individual peculiarities. Rewriting of the work for this edition was hence deemed unnecessary. It was thought best, however, so to outline in an introduction the working of the developmental principles governing heredity and environment as to facilitate their application to the topics discussed in the different divisions of the subject.

INTRODUCTION.

More than thirty years ago, an extensive dental experience convinced me that in developmental processes the face, nose, jaws and teeth were more involved than the rest of the body, and were, therefore, under the laws of economy of growth, hence most involved in pathologic change. This, as now generally recognized, is underlain by developmental states, distorted into excess or diminution. Evolution or development proceeds from the indefinite simple to the definite complex with a resultant saving in expenditure of force. As embryologic development in man proceeds from the simple cell to a union of cells forming structures, organs, and finally the body which these unite to form, two processes take part in it: degeneration of cell functions to secure greater specialization in the organs they form, and degeneration in these organs for greater accomplishment by the body of certain functions with less waste or force. Evolution of the body as a whole is aided by these degeneracies. When degeneracy diminishes lower structures for the advantage of the higher, evolution is the type of progress; when degeneracy attacks the higher structures for the benefit of the lower, as in parasites, degeneracy is the type of progress.

Evolution of this type strikes its roots deep and early in Greek philosophy, where Empedocles, long before Aristotle, outlined the doctrine of evolution and survival of the fittest. Aristotle cleared up the relation of structures and organs to each other, and the sacrifice of one to another for the benefit of a single organ or the body as a whole. This principle, which demonstrated the amount of nutriment which could be assimilated, was limited, and that active organs must secure most was cleared of obscurity first by Goethe in 1807, and still more by Geoffroy St. Hilaire in 1818. Roux later applied it to physiology and pathology. Upon it turn all biologic processes. It explains all so-called freaks of nature, which

are simple retroversions of evolution. The general trend of the mixture of degeneracy and evolution constituting advance is to the creation of checks on waste, constituted by a balance secured by a more and more complex central nervous system. The explosive motor expression of the ganglionic nerve system is lessened as the central nervous system gains more ascendancy in passing upward from the sea-squirt to man. This ascendancy is shown in the reduction of nerve force needed in sensation, motion or in nutritional processes. With rise in evolution or with growth in human embryogeny, the brain gains at the expense of the spinal cord and at the expense of the structures of the face. More brain space is needed, and the dermal bones which cover this space gain at the expense of the vertebral structures entering into the skull and face. The human face, with all its beauty, considered from the standpoint of food-getting, chewing and combat, is, as Minot has shown, assuming an embryonic type. The jaws are needed less and less for the purpose mentioned, hence, under the law of economy of growth, the resultant disuse sacrifices them for the benefit of the growing brain and nervous system and the dermal elements of the skull. Under this operation of the law of economy of growth has occurred the æsthetic evolution of the face from the anthropoid to the Apollo Belvidere type, which Camper has so graphically pictured. The reverse phase of evolution, with which Camper did not deal, is that of which the present work treats. This phase of evolution underlies all pathology of the face, as well as of the nose, jaws, alveolar process and teeth. The illustrations supplementing those of Camper portray this reverse phase where symmetry of the body as a whole is sacrificed to changes in the nose, jaws, alveolar processes and teeth, so as to preserve brain gains.

The following illustrations, taken from photographs of patients, accurately portray arrests of the face for the benefit of the brain. The gradual recession of the face and the forward development of the brain is a gradual continuation of Figure 36 in the line of evolution. From the relations of this face degeneration nearly all diseases of the nose, jaws, alveo-

lar processes and teeth result. In many cases reverse evolution progresses still further till, owing to an unbalanced

nervous system and movements of the lower jaw, atavism results. Figure 8 and Figure 9 exhibit a greater exaggeration of the lower jaw, a return to the anthropoid and lower negro type.

PREFACE.

The earlier editions of the present work were as remarked in 1894 an outgrowth of researches which tended to oppose the too prevalent theory (erroneous in its deductions and vicious in its effects on practice) that irregularities of the teeth and jaws were the result of local not constitutional conditions. In the present volume in accordance with the general trend of medical science, biologic data have largely been used in the explanation of pathologic and teratologic results. This is nothing new in dental science nor in general medical science since the sciences separated from fetichism. At all times, lower animals have been used as a means of solving pathologic and physiologic problems. The close of the last century has, however, witnessed an attempt to use such methods philosophically. The known structural and functional differences between the animal and man have been employed in control experiments. In the use of embryology in explanation of physiologic and teratologic abnormality the present work has merely followed the trend of clinical investigation. An attempt has been made to control errors resultant on clinical observation by analysis based on the general principles of physiology and pathology. While the present work contains abundant clinical evidence in favor of the views advanced, this evidence has been critically analyzed from biologic, embryologic, physiologic, pathologic and sociologic standpoints. Many of the results obtained through researches elsewhere recorded ("Degeneracy: Its Causes, Signs and Results," and "Interstitial Gingivitis, or So-called Pyorrhoea Alveolaris") are used in the present work as starting points. As embryology, biology and teratology (science of deformities) are extensively used in current dental literature in explanation of human dental processes, no apology need be made for their employment in the present volume. The present work is practical in the highest sense of the term which means avoidance of "rule of thumb" theories based on exploded obsolete charlatanish notions.

The abnormal eruption of the teeth into facial cavities other than the oral has rendered a discussion of these cavities absolutely necessary for the purposes of the dental surgeon. Unless the development, teratology and pathology of these cavities be understood a clear, comprehensive conception of the relations of irregularities of the teeth is unattainable. When the third edition of the work was in the hands of the profession it became apparent to the author from the opinions of reviewers and of dental and medical journals, as well as from letters received, that the prevalent conception of degeneracy as a factor of growth was obscure and misleading. An extended and comprehensive examination into the subject seemed imperative and the result of this examination was the production of the work upon "Degeneracy: Its Causes, Signs and Results," published by the firm of Walter Scott of London, England. This work has met with enthusiastic commendation not only from biologists but likewise from conservative physicians, who, like the venerable Dr. N. S. Davis of Chicago, are of a belief that "it has opened up a new field in medical science."

To understand and appreciate the pathology of the alveolar process both works (Interstitial Gingivitis, or So-called Pyorrhoea, Alveolaris and Irregularities of the Teeth) require comparative study.

The unwritten law in general medicine, "that to know the cause is half the treatment," is also applicable in the treatment of deformed jaws and irregularities of the teeth. Believing in this law the author has devoted his time outside of office practice to this particular department of the specialty. Without the knowledge of etiology no one can successfully correct deformities as is evident in the many failures by men who profess to make this a specialty. In the preparation for the fourth edition, the entire work has been re-written and re-arranged with plenty of new material and new facts, the result of twenty-six years of constant research. The etiologic views advanced in the third edition of this work were not generally understood, probably because of difficulty of harmonizing the various disorders of the body with the law of economy of growth.

The author has indelibly stamped his individuality in the first

part of his work, but still more is this the case in the second part. He has confined himself entirely to his own appliances and methods of treatment. "Systems" in the ordinary charlatan-like sense are not accepted as guides. In the author's opinion the practitioner should be familiar with the etiology of the case in hand; his knowledge of principles and mechanics should suggest to him the most suitable appliances for the given case. Every force has its place in the treatment of these deformities. The appliances here illustrated have all been successful in the hands of the author when used according to their indications.

For preparation of specimens discussed in Chapter on Pathologic and Physiologic Changes, the author is under obligations to Drs. L. Hektoen, M. Herzog and F. Noyes.

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103 State Street. EUGENE S. TALBOT.

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IRREGULARITIES OF THE TEETH.

CHAPTER I.

HISTORY.

Dentistry was a very early specialty of medicine. The Assyrians, according to recent investigations by Sayce and others, early practiced tooth filling with gold and allied procedures. The folklore belief that dental decay was due to a worm in the tooth however exerted more influence then than it does now among Aryan-speaking peoples other than in the Western Highlands of Scotland, Ireland, Poland, Russia, France, Italy, South Germany and Spain. The Assyrians did not reach a level in medicine and surgery higher than that of the Chinese of to-day, who are presumably the inheritors of their science. In Egypt nearly every branch of medicine had attained a relatively high status at the time of Herodotus. Even earlier, as shown by the Ebers' papyrus, dentistry was a differentiated specialty of medicine. Gold was employed by the Egyptians not merely for the purpose of filling teeth but likewise to correct irregularities. Mummies are found containing teeth held in place and directed by gold or silver wires or plates. In Hindoo civilization dentistry early reached also a high status as a specialty of medicine, albeit such civilization fell later into decay when the folklore notion of disease due to the worm in the tooth resumed its prominence. In the time of Hippocrates, caution was used in extracting teeth and preserving them. Hippocrates attacked principally the fetichic origin of disease. As this played a large part in compelling unnecessary extraction of teeth he naturally was led to describe the characters of teeth and the indications for their extraction. A hundred and sixty years after him Erasistratus[1] deposited in the temple of Apollo at Delphos an odontogogue or leaden tooth forceps, intimating that only teeth should be drawn which were loose enough to be extracted with this instrument. This (an ex-voto offering for recovery from disease) was probably intended by Erasistratus as a popular lesson against too early

[1] Baas' History of Medicine.

extraction of teeth. So far as dentistry is concerned the Romans were as much influenced by Etruscan as by Greek culture, although this last had a very early influence. The Etruscans practiced dental procedures resembling but more complete even than those of Greece. In Rome artificial teeth and dentures evidently modeled on Etruscan types were made ere the period of the laws of the "Twelve Tables." Celsus (A. D. 30) practiced dentistry rather in rough surgical manner than by these conservative methods. Galen (150 A. D.) gave the canine teeth the present popular term "eyeteeth," because he believed they were supplied by the optic nerve. Greek, Etruscan, Roman and Arabian culture met at the famous school of Salernum, which sprang up about 700 A. D. Under its influence dentistry was more practiced by surgeons and physicians, whereas it had been previously largely confined to charlatans. Bruno of Lango-buro, about the middle of the thirteenth century, described various operations upon the teeth and antrum nearly four centuries before Highmore. In the fifteenth century Giovanni d'Arcoli filled teeth with gold and made attempts at corrections of irregularities. In 1618 the famous anatomy of Helkiah Crooke was published. From this Shakespeare drew many illustrations. It not only discussed the brain and its membranes, but even variations in the numbers of molars. Before this in France, Dionis and Verduc had made contributions along the line of the correction of irregularities. The first great French work on dentistry issued in 1728 by Fauchard was "Le Chirurgien Dentiste." Auzebi of Lyons soon after wrote a similar work. In Germany the influence of the French, Italian and English schools is demonstrated in the recognition of the dental specialty in Universities by creation of special chairs.

Irregularities of the teeth were therefore very early recognized, and, equally early, attempts were made at their correction. To the considerable extent of this recognition, in prehistoric times, comparatively speaking the work of the Etruscans bears witness. The same influences which have ever aided radical surgery at the expense of conservative, were predominant in dentistry. It was easier to remove teeth with the charlatan than to preserve them with the dental scientist.

Crooke, discussing second dentition, remarks that: "the shearing (i. e., incisors) teeth, when they do break forth, do thrust the first shearers out before them and issue betwixt the first two, the second and the dog tooth that is next unto them. But if the former teeth will not fall or be not pulled out, or if the latter issue before the first fall, then the latter make their way through new sockets, and turn in the upper jaw outward, in the lower jaw inward, so that there seemed to arise a new row of teeth and this hath deceived many historians and anatomists also."

The views of Crooke seem to have impressed later students of dentistry more than was first apparent. During the next two centuries are found references to conditions produced by supernumerary teeth on the one hand and narrow jaws on the other. Barth Ruspini a century and a quarter after Crooke claims that all teeth which exceeded thirty-two may be regarded as supernumerary. In his opinion irregularities of the canines and incisors were attributable to extreme narrowness of the jaws.

Half a century later Robert Blake[2] describes supernumerary and inverted teeth. A little over three decades later than Blake, Joseph Harris[3] and Joseph Winckworth remarked that irregularities were due to supernumerary teeth.

As the views of irregularities broadened, studies of their causation became imperative. For the same reason that local causes assume undue prominence in medicine, they suggested themselves to dentists studying irregularities of the teeth. Among these causes (still in considerable favor among dentists, laryngologists and general practitioners) may be mentioned thumb-sucking, mouth-breathing and enlarged tonsils. Although thumb-sucking is claimed as a late nineteenth century explanation of irregularities of the jaws and teeth, it was given as a possible explanation by J. Imrie[4] nearly six and one-half decades ago. He remarks that "Irregularity is due to want of development of jawbones, intemperance of various kinds combined with artificial modes of living introduced by civilizaton and sudden tran-

[2] Inaugural Dissertation, 1798.

[3] A Familiar Treatise on the Teeth, 1830.

[4] Parent's Dental Guide, 1834.

sition from heat to cold to which the teeth are subject. All these have a tendency to prevent development of the bones. Rabbit mouth is due to keeping the thumb in the mouth for hours after going to sleep. Underhung jaw is due to sucking the tongue by throwing the under jawbone from its articulation. A similar state of the teeth and jawbone is induced when attempts are made by the inexperienced to regulate them by the extraction of teeth in the upper jaw and neglecting to remove an equal number of the lower."

J. Lefoulon[5] is of opinion that the most frequent cause of dental irregularity is the neglect of proper supervision of the second dentition. Very often the temporary teeth are too precipitately removed and again the opposite error is committed by suffering them to remain after the permanent have partly appeared. From this results an error of relation between the development of the palatine arch and the superior alveolar border, or of the two arches at once relatively to the size of the teeth. Another cause is the bad habit of permitting children to suck their thumbs and continually to be putting their thumbs into their mouths. Another cause is the frequently repeated action of the tongue in the pronunciation of certain syllables called lingual, in which that organ striking against the anterior superior teeth gives rise to anterior obliquity of the superior arch. This deformity very frequently results among the English-speaking from pronunciation of lingual syllables.

The same year Thomas Ballard charged that serrated teeth and projecting jaws were the result of fruitless sucking.

According to Stockton[6] "The comparative ease by which, with pressure, the incisors or bicuspids may be made to alter their position would naturally suggest the idea that the tongue, lips, or cheek might in some measure influence their original direction. But as these are pressed by everyone, while certain individuals only have their teeth moved unevenly arranged, we must look for some other accessory, and this may be found in the form of the palate, certain peculiarities of which are found in connection with similar forms of the dental arch. Irregularity of

[5] Theory and Practice of Dental Surgery, Bond's Translation, 1844.
[6] Dental Intelligencer, 1845.

position is almost exclusively confined to the five anterior teeth on each side of the medial line, brought about by the pressure of the tongue upon the hard palate in sucking or mastication."

According to Nasmyth[7] the projecting upper jaw often results from the habit of sucking the thumb or finger in infancy. But both projecting upper and projecting lower jaw arise from arrest of development in the jaw when the expansion of the arch is deficient. The prominent mouth, in his opinion, is most frequent in civilized races.

The influence of thumb-sucking was still more emphasized eight years later by H. H. Ross, who at the same time remarked that as soon as there was an attempt at correction, there was greater difficulty in keeping the teeth in position after they were moved than in moving them. During the next twenty years opinions as to the influence of thumb-sucking continued to grow in number. In 1873 A. A. de Lessert attributed great influence to thumb-sucking and to enlarged tonsils. Thomas Salter[8] attributed irregularities to thumb-sucking and tongue hypertrophy. J. W. White was of opinion that protrusion of the lower jaw was due to the habit of sucking the first and second fingers. The weight of the hand and arm exerted an influence in causing a protrusion of the lower jaw and teeth.

In Francis Fox's[9] opinion the causes of irregularity were "The want of proportion in the size of the teeth and the jawbones or prolonged retention of temporary teeth, supernumerary teeth, the habit of thumb-sucking, undue pressure from an hypertrophied tongue or heredity.

In Helkiah Crooke's summary of the opinions of his day the influence of the temporary teeth in producing irregularities had been pointed out. These views influenced not a few succeeding investigators. About a century and a half after the appearance of Crooke's work Thomas Berdmore claimed that the presence of supernumerary teeth or of a double row of teeth is due to the fact that the milk teeth are never shed notwithstanding the fact that the permanent teeth appear. Irregularity of the

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[7] Development, Structure and Diseases of the Teeth, 1845.

[8] Dental Surgery, 1874.

[9] Irregularities of Teeth and Their Surgical Treatment, 1880.

teeth is due to the resistance offered by the permanent by the temporary, which also occasioned snaggled, rough and indented teeth.

According to Joseph Fox[10] the most frequent cause of irregularity is a want of simultaneous action between the increase of the permanent teeth and the decrease of the temporary ones by the absorption of their fangs, most commonly occasioned by the resistance of the nearest temporary teeth. It also results from the fact that the permanent teeth are too large for the space occupied by the temporary. The growth of more teeth than the natural number frequently occurs and is always the cause of greater irregularity of the teeth.

Joseph Murphy[11] regards irregularity as due chiefly to the first teeth not having been shed in time.

In the opinion of Benjamin James[12] proper attention to the removal of the first teeth avoided irregularity of the second set.

Parmly[13] is of opinion that want of attention during the period of shedding the first set of teeth is the great cause why irregularity of the teeth, and consequent deformity of the mouth, are apt to take place. When the permanent are large and growth of the jaw does not proceed in a corresponding proportion they are found to crowd and overlap each other. G. Waite[14] found that irregularities of the teeth are mostly occasioned by the pressure of the temporary upon the permanent, throwing them in the wrong direction.

According to S. S. Fitch[15] irregularity is due to want of simultaneous action between the increase of the permanent teeth and the decrease of the temporary by the absorption of their fangs, as well as to greater size of the permanent teeth in comparison with the temporary. This is an adoption of the views and even of the language of Joseph Fox.

J. B. Garriot[16] is of the opinion that deciduous teeth by their

[10] Natural History of Human Teeth, 1803.

[11] Natural History of Human Teeth.

[12] Management of the Teeth, 1814.

[13] Natural History and Management of the Teeth, 1820.

[14] Surgeon-Dentist's Anatomic and Physiologic Manual, 1826.

[15] System of Dental Surgery, 1835.

[16] Treatise on Diseases of the Mouth, 1843, Savier's Translation.

presence often prevent the permanent teeth from arranging themselves in their proper position. Neglect to extract the milk teeth and of other measures favoring good arrangement of the permanent teeth, deformity (often very serious) may result.

One possible factor of dental irregularities which had been very early considered was peculiar growth of the jaw. This was discussed, as has been already remarked, by Barth Ruspini in 1750. The great biologist, John Hunter, who paid some attention to this factor, states[17] that the jaw grows at the posterior edges and that an irregularity is often due to the ten anterior permanent teeth being larger than the ten anterior temporary teeth, while the corresponding part of the jaw is of the same size. Therefore, in such cases the second set is obliged to stand very irregularly.

From observations made on young pigs, G. M. Humphrey claims that there is no interstitial growth. The five permanent teeth occupy exactly the same position throughout life and all other conditional teeth are added to the hinder end of the jaw. This hind end is enlarged by the absorption of the anterior coronoid edge and the deposition on the posterior edge. When the molars are first formed they are under the coronoid process and are frequently exposed.

Another factor which received considerable attention both as a predisposing and exciting cause is premature extraction of temporary teeth.

According to the work of L. Koecker, published in 1826, the deformity which consists in shutting the under incisors and cuspidati over the upper has been produced by the injudicious extraction of some of the teeth of the upper jaw without taking proper care to secure due proportion between the upper and under jaws. Irregularity also occurs when the temporary teeth are not extracted in time and when too long persistence of these occurs.

According to Thomas Bell[18] the most unusual cause of permanent irregularity is the actual want of sufficient room in the jaw for the ultimate regular arrangement of the teeth. This may

[17] Natural History of the Teeth, 1771.

[18] Anatomy, Physiology, and Diseases of the Teeth, 1829.

occur from disproportionate narrowness of the jaw (whether from original formation or produced by too early removal of temporary teeth) or from prenatural size of the permanent teeth.

In Joseph Scott's[19] opinion, irregularities arise from, first, a natural want of sufficient expansion in the jawbone at the time of their protrusion; second, from not extracting the temporary teeth at the proper time; third, from too early extraction of the temporary teeth; fourth, from supernumerary teeth.

John Nicholles[20] found that deformity may be due to too long persistence of the temporary teeth, or may arise from some malformation of the teeth or jaw entirely beyond the previous control of the dentist.

According to M. Maclean,[21] due expansion of the jaw is prevented by premature extraction of the temporary teeth. The temporary teeth being not extracted, the permanent teeth are thereby crowded and irregular.

E. Spooner[22] has found that the first and most frequent cause of irregularity is a want of simultaneous action between the protrusion of the permanent teeth and absorption of the fangs of the temporary. The second cause is a narrowness of the maxillary arch or a want of proportion between the extent of it and the size of the teeth. Another cause is premature extraction of the temporary teeth. The jaw is liable to contraction and when the permanent come in there is not room in the jaw for them, irregularity is due also to supernumerary teeth.

According to William Thornton[23] irregularities of the teeth proceed from three causes. First, from a natural want of sufficient expansion in the jawbones at the time of the protrusion of the teeth; second, not extracting the temporary teeth at their proper time; third, too early an extraction of the temporary teeth.

Mortimer about the same time expressed the opinion that irregularities of the teeth arise from natural or accidental causes. Natural causes arise from the bad conformation of the jaw so

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[19] Art of Preventing Loss of Teeth, 1831.

[20] Teeth in Relation to Beauty, Voice, and Health, 1833.

[21] Treatise on Human Teeth, 1836.

[22] Popular Treatise on the Teeth, 1836.

[23] Treatise on the Preservation of the Teeth and Gums, 1836.

that several teeth are over each other. From the teeth being much larger than they should be, from coming out of order and place, from teeth growing out of the palate or projecting out of the mouth. Accidental causes arise from neglect or ignorance in removing milk teeth too soon; when the second teeth take a direction inward or outward from some internal cause; underhung jaws arise from making faces.

According to Charles de Loude[24] irregularity is due to supernumerary teeth, to second teeth being too large and maxillary arch too narrow, and too early extraction and too long persistence of temporary teeth, and to shape of the maxillary arch, and to heredity, where the child inherits the jaw of one parent and the teeth of another.

About three years later Sam Ghimes spoke of the underhung jaw being due to the upper incisors extending inwards and in closing the mouth they come in contact with the lower. This makes the child inclined to protrude the lower jaw, which finally becomes habitual and promotes the increase in the length of the jaw itself.

Nessel[25] attributes irregularity to the premature extraction of temporary teeth. The alveoli form a bone scar in such cases which constitutes an obstacle to the advancement of the permanent teeth. In consequence the permanent teeth come before the jaw is sufficiently expanded to receive them. Between 1860 and 1880 mouth breathing, especially during sleep, formed a prominently discussed etiologic factor.

Tomes[26] expressed the opinion that deformity of the jaw is often caused by sleeping with the mouth open. This factor Tomes had not mentioned in the 1848 edition of his work. Catlin, the ethnologist, made a great popular propaganda in favor of nose breathing. He ascribed many diseases to keeping the mouth open. Malformations of the jaws and teeth were due to keeping the mouth open, since civilized man is the only animal who keeps his mouth open during sleep. This view still meets

[24] Surgical, Operative and Mechanical Dentistry, 1840.
[25] Compendium der Zahnheikunde, 1856.
[26] Dental Surgery, 1859.

with much favor among dentists and laryngologists. It is, however, losing caste with the paediatricians.

W. Matthews[27] sixteen years later than Catlin advanced similar views. Irregularities were attributable to enlarged tonsils which necessitate breathing being carried on with open mouth. They were also due to heredity. The maxilla was smaller in proportion than the teeth, owing to the lessened work of the jaws and teeth among civilized races. Cross breeding played an important part, as did thumb-sucking and lip-sucking; retarded shedding of the temporary teeth and too early extraction of the first permanent molars. The congenital V-shaped jaw is that formed where, previous to birth, the type of upper maxillae is such that its cornua do not diverge posteriorly but are parallel. As that portion of the jaw already formed never changes its form, the newly added parts will pass off in divergent lines, forming an angle with previously existing in order to correspond with the increasing width of the base of the skull. The growing tendency, exhibited from the time of Crooke, to assign constitutional factors important places in the etiology of the teeth and jaw irregularities, is especially observable in the work of Matthews. He, while laying stress on local factors, was forced to recognize the importance of constitutional factors. Constitutional factors, hence, early began to assume considerable importance. John Fuller, while attributing, in 1810, irregularity to long persistence of temporary teeth, also remarked that the upper jaw is often too small for the permanent teeth, this condition frequently resulting in its irregularity. In Sigmond's[28] opinion, irregularity is due to natural and accidental causes. Causes are natural: (1) when they result from the jaw not expanding sufficiently to allow the teeth to form a regular circle; (2) when they are larger than the ordinary dimensions; (3) when they do not appear in their proper order and place. Causes are accidental when due to negligence or improper treatment at the time of growth.

According to Andrew Clarke,[29] that irregularity of the teeth is occasioned by want of room in the jaw, and not from any

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[27] London Dental Hospital Transactions, 1880.

[28] Treatise on Disease and Irregularities of the Teeth and Gums, 1825.

[29] Practical Directions for Preserving the Teeth, 1825.

effect that the first set of teeth may produce upon them, is evident from the fact in all cases of irregularity there is not room to admit of placing the teeth properly.

According to J. P. Clark[30] irregularity may arise from too premature extraction of temporary teeth. Disproportion between the teeth and jaws may be occasioned by a natural conformation of the parts or may be the effect of unnoticed accident. For we seldom found any such disproportion and consequent irregularity in the teeth of men and animals in a wild state.

According to William Robertson[31] deformity is due to inheritance of the contracted jaw of one parent and the large teeth of the other.

According to David W. Jobson[32] an irregularity is due to smallness of maxillary arch and the great size of the permanent teeth and their situation, part on inner and of others on outer side of permanent teeth.

John Mallan[33] remarks that the adult teeth being larger as well as more numerous than the milk teeth, it is obvious that they require a great deal more room, and when the absorption of the latter does not progress equally with the growth of the former, the new teeth are crowded up and are apt to be forced out of their natural position by the resistance of the old. Again, if the permanent prove, as they sometimes do, disproportionately large in comparison with their predecessors, the jaw may not be sufficiently extended to admit of their being arranged in order, in which case some overlap the others and considerable deformity is occasioned.

According to Maury[34] prominence of the upper jaw is due to narrowness of the arch; recession to the anterior teeth. Paul Goddard[35] expresses the opinion that the most prolific cause of irregularity is want of room in the dental arches. This arises sometimes from congenital effects but more commonly from

[30] A New System of Treating Human Teeth, 1829.

[31] Practical Treatise on the Human Teeth, 1841.

[32] On the Teeth, 1834.

[33] Practical Observations on Physiology and Diseases of the Teeth, 1835.

[34] Dental Art, 1842, Savier's Translation.

[35] Anatomy, Pathology and Physiology of the Teeth, 1844.

early decay and loss of the temporary teeth which, failing to keep up the alveoli, enable the jaw to contract and thus afford too little room for the permanent set.

According to C. A. Harris[36] an infringement of the laws of growth or disturbance of the organs of the face or head may determine improper development of the jaws and bad arrangement of the teeth. Irregularity of the teeth is due to narrowness of the maxillary arch and sometimes to the presence of the temporary teeth.

Arthur[37] states irregularities of the teeth may proceed among other things from three principal causes: First, the presence of the greater number of teeth in the mouth than is natural. Second, a deficiency of space in the jaw. Third, a wrong direction given to one or more at the time they make their appearance. A deficiency of space may arise from a contraction of the jaws in consequence of the too early extraction of the temporary teeth; or from some original malformation of the jaw, or from a great excess in size of the second set over the first.

According to W. K. Brideman[38] the tongue, lips and cheek exert no influence in moving the teeth from their original direction. This is due to the shape of the jaw.

According to Sam Harbert[39] irregularities of the teeth are due to premature extraction of the deciduous teeth and protrusion of the permanent before the absorption of a deciduous fang. A projection of the lower jaw is attributable to neglect in second dentition. Generally it is supposed to be due to elongation of the jaw which is almost always an error. When the dental arch becomes contracted at the medial line, giving to the mouth a pointed appearance, it is often the result of premature extraction of temporary teeth.

According to Alfred Canton[40] irregularity of teeth, as regards shape, position, direction, crowded condition, etc., is met with more frequently than is supposed to be the case. The causes

[36] Principles and Practice of Dental Surgery, 1845.

[37] A Popular Treatise on Diseases of the Teeth, 1845.

[38] Causes of Irregularities of the Teeth, 1845.

[39] Practical Treatise on the Operations of Surgical and Mechanical Dentistry, 1847.

[40] Teeth and Their Preservation, 1851.

are chiefly mechanical, depending either on the non-increase in size of the jaw in proportion to the growth of the teeth to be contained in the alveolar arch; on the position of the permanent teeth with reference to the fangs of their predecessor, and lastly, on the increase in size of one jaw in preference to the other.

C. F. Delabarre[41] is of opinion that malformation of denture may be occasioned by defective conformation of the jaw, by simple arrest of development dependent upon the health of the individual by excess in development of the teeth though the jaws be in other respects well formed, by rapid development in the dentition of one set and delay in that of the other by the too great size of the teeth of one jaw which do not harmonize with those that are opposite. Some forms of defective palatine arches are hereditary.

According to J. R. DuVal[42] in a projecting chin, the alveolar arch in which the incisors and canines are placed, has taken a development upon a parabolic line—greater and more prominent than that presented by the bone. This differs very little from a similar one in the upper jaw which projects over the lower. Upon attention to shedding of the temporary teeth depends the fine arrangement of the lower.

Gunnell[43] finds that protrusion of the lower jaw, while in many cases hereditary, is often brought about in the following manner. The incisors of the lower jaw are cut first, and when the upper ones appear, the lower have nearly arrived at full growth. In closing the mouth, they come in contact with the gum on the inside of the upper incisors and for relief the lower jaw is thrust out, which condition soon becomes permanent.

According to Samuel Cartwright, Jr.,[44] irregularities of the permanent are due first to non-absorption of the roots of the temporary teeth in proportion to the rise of those of replacement. Second, to the great difference which commonly exists in the size of the new teeth as compared with those of the first set. Third, to contraction of the arches of the jaws and other malformations

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[41] Treatise on Second Dentition.

[42] The Youth's Dentist.

[43] Americal Journal of Dental Science, 1853.

[44] British Journal of Dental Science, 1857.

of the maxillary and palate bones originating in hereditary, congenital and other causes.

In 1860 extensive observations were made by Messrs. Mummery and Nichols upon the teeth of primitive races.[45] They found that irregularities of the teeth and contracted jaws were rare. Observations of Messrs. Coleman and Cartwright on primitive skulls found in Kent, England, showed that these had well developed jaws and alveolar arches. The teeth still present were remarkably regular.

In a paper read before the British Odontologic Society Samuel Cartwright expressed an opinion in 1864 that irregularities result from selective breeding; that they are both congenital and hereditary; that there is very little increase in the anterior part of the jaw after eight or ten years. That if the temporary teeth were to remain the jaws would not change from those of childhood. That in all cases of irregularity the maxillæ are more or less altered in proportion of development whilst the teeth maintain in regard to size an average development.

According to A. A. Blount,[46] remote causes which produce irregularity will be found in the commingling of all nations with national and individual characteristics. The most frequent causes are the result of accident, indiscriminate action of the deciduous teeth and too early extraction of the permanent teeth.

According to H. Sewell[47] protrusion of the incisors is apparently due to an abnormal development of the maxillary bone. Irregularities are due to retention of temporary teeth causing permanent teeth to assume an unnatural position; also to malformation of the jaw, which is usually congenital and at the same time hereditary. They may be due, however, to injury and to accidental causes.

J. L. Down[48] found that excessive vaulting of palate is due to arrest of development of the sphenoid or defective growth of the vomer. The defects are development defects and betoken

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[45] Jaws and Teeth of Semi-Barbarous Races.

[46] Orthodontia, 1866.

[47] Irregularities and Diseases of the Teeth, 1869.

[48] Relation of Teeth and Mouth to Mental Development.

a cause long anterior to the time when sucking the thumb is practiced unless that habit be an intra-uterine one.

In the opinion of Hepburn[49] contracted maxillæ and alveoli are the result of artificial life and other causes attendant on civilization. Anthropologists affirm that with the advance of civilization there is decrease in the size of the facial and maxillary bone. Cross-breeding also plays a part in producing deformity. In the work of Kingsley, irregularities are attributed chiefly to premature extraction of temporary teeth, marriage between persons of different nationalities, heredity or disturbed innervation.

S. H. Guilford[50] divides the causes into hereditary and acquired. Colyer[51] summarizes the opinions of the previous writers into the statement that the causes which produce irregularities of the teeth are general and local.

In 1901, W. Arbuthnot Lane[51a] called attention to the association of deformities of the alveolar process and constitutional deficiencies (like those of the chest) referring the deformities to the action of local factors and ignoring the underlying constitutional element.

Ere the publication of Kingsley's work, I became convinced of the importance of acquired constitutional as well as of factors of hereditary origin. In 1887 I demonstrated before the Ninth International Medical Congress the following propositions by results the fruit of decades of constant research. The peculiarity in the size and shape of the jaw bone may be inherited but the manner of the eruption of the teeth is not transmitted, hence irregularities of the dental arch per se are not inherited. The muscles of the cheeks have nothing to do with the production of the V or Saddle arch. The only tissues involved are the jawbone on the one hand the teeth and alveolar process on the other. The incisors in the V-shaped arch always protrude; in the Saddle arch never. The manner of the formation of the V and Saddle arches is in the arrangement of the teeth. No matter what posi-

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[49] Irregularities of the Teeth and Their Treatment, 1870.

[50] Orthodontia, 1898.

[51] Irregularities of the Teeth, 1900.

[51a] The Clinical Journal, March 20, 1901.

tion the teeth may take, the alveolar process is dependent upon the teeth for its shape and position. There is a decided difference between the deformities produced by thumb-sucking and those of the V and Saddle arches. Arrest of development and excessive growth of the maxillary bone result as follows: The last but not least of the causes of arrest of development of the maxillary bones is the influence of constitutional disorders and the eruptive diseases. Debilitating acute diseases in children are noticeably often followed by sudden overgrowth or undergrowth of bone. This process affecting the jaw accounts for a certain proportion of those cases of pneumonia and measles followed by dental irregularities and maxillary deformities.

The relation of this local osseous neuro-trophic change to the neuro-pulmonary and neuro-cardiac effects of measles and pneumonia and to the extensive osteo-tropho-neurotic changes in the pneumo-cardiac type of acromegaly later described by Marie, is evident. Behind both lie the predisposing factor of an inherited or acquired neuropathic state evinced at the periods of stress marked by dental evolution or involution.

In some cases the process is a low grade of inflammation with secondary atrophy instead of hypertrophy.

Subsequently, I showed that irregularities of the teeth were often due to two factors. Those of constitutional origin which develop with the osseous system and those of local origin. Irregularities of the teeth cannot occur until they have erupted (as nothing can exist except it be present) and thus shown their relation to each other and to the jaw. The deformity always commences at the sixth year and is completed at the twelfth. Forward movement of the posterior teeth produce the same result as arrest of development of the maxillæ. It was also shown[52] by a large number of measurements and actual cases in practice: That the vault is not contracted by mouth breathing. That contracted dental arches are as common among low vaults as high and that they simply appear high because of the contraction. That mouth-breathing (due to hypertrophy of the nasal bones and mucous membrane deformities of the nasal bones, adenoids

[52] Mouth Breathing Not the Cause of Contracted Jaws and High Vaults, 1891.

or any pathological condition producing stenosis) does not cause contracted jaws, but all these conditions are due to neuroses of development. These views have met with considerable opposition, yet the clinical evidence in their favor has continually grown. On the continent of Europe their practical acceptance has been shown in the recent translation by Max Bauchwitz[53] of my work on the subject.

[53] Die Entartung der Kiefer des Menschengeschlechtes; Eine Studie von Eugene S. Talbot, Uebersetzt und Frei Bearbeitet von Max Bauchwitz, Leipzig, 1898.

CHAPTER II.

HEREDITY.

The individual that comes into the world is, as Luys[1] remarks, but one link in a long chain which is unrolled by time and the first links of which are lost in the dim past. He has not merely two parents but the ancestors behind these. These two parents may represent ancestors of very different type whose qualities seemingly absent in the parent will appear in their descendant. The relative functions of the sexes in heredity are moreover a potent factor to be taken into consideration in estimating its influence. The original function of reproduction, that of cell division, is the part of the female. The male in the lower types of life (some plants and some infusoriæ) simply supplies the female with nutriment. With a rise in evolution protoplasm is differentiated. The female furnishes the type which is best capable of development when properly nourished by a highly developed male.[2] As the product of fructification is longest under the nutritive influence of the female, her influence is most potent in redeeming defects or producing them. "It is, therefore," as Moreau (de Tours[3]) has well said, "an incorrect conception of the law of heredity that looks for identical phenomena in each succeeding generation. Some have refused to admit that mental faculties were subject to heredity because the mental characters of the descendants were not precisely those of the progenitors. Each generation must copy the preceding. Father and son must present the spectacle of one being, having two births, and each time leading the same life, under the same conditions. But it is not in the heredity of functions or of organic or intellectual facts that the application of the law of heredity must be sought, but at the very fountain head of the organism, in its inmost constitution."

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[1] Maladies Mentales.

[2] Geddes-Thomson Evolution of Sex.

[3] La Psychologie Morbide.

Heredity, as I have elsewhere pointed out,[4] is divisible into direct heredity, indirect heredity and telegony.[5] The direct heredity consists in the transmission of parental and maternal qualities to the children. This form of heredity has two aspects: The child takes after the father and mother equally as regards both physical and moral characters, a case, strictly speaking, of very rare occurrence; (2) or the child, while taking after both parents, more especially resembles one of them. Here again distinction must be made between two cases. The first of these occurs when the heredity takes place in the same sex from father to son or from mother to daughter. The other, which is more frequent, appears when heredity occurs between different sexes from father to daughter or from mother to son. Reversional heredity or atavism consists in the reproduction in the descendants of the moral or physical qualities of their ancestors. It occurs frequently between grandfather and grandson, as well as between grandmother and granddaughter. Collateral or indirect heredity, which is a rarer occurrence than the foregoing and is simply a form of atavism, subsists, as indicated by name, between individuals and their ancestors in the indirect line—uncle or granduncle and nephew, aunt and niece. Finally there is telegony or the heredity of influence (very rare from the physiologic point of view), which consists in reproduction in the children by a second marriage of some peculiarity belonging to a former spouse.

The descendants of a victim of morbidity or abnormality do not always exhibit the morbidity or abnormality of the ancestor. Sometimes apparent morbidity or abnormality is wanting. In other cases slighter abnormalities than those of the ancestor are to be detected. Here occurs the operation of two interdependent principles. The transmutation of heredity and the atavism upon which it depends. Atavism at times tends to preserve the type and offsets the influence of degeneracy. It underlies not merely the production of the sound actions of degenerate stock, but also those in whom the degeneracy affects the earlier and not the later acquirements of the race. Manifestations of mor-

[4] Degeneracy: Its Causes, Signs and Results.

[5] Ribot Heredity.

bid heredity may not be inheritance of the whole effect but disturbance of relations of structure, and hence of function, producing a constitutional deficiency which takes the line of least resistance. The extent and direction of this line of least resistance depends upon the amount of healthy atavism which separate organs and structures of the body preserve. What is true of the organism as a whole is true of the cells forming its organs. While cell life is altruistic or subordinated to the life of the organ and through it to the life of the organism as a whole, still this altruism is not so complete as to prevent entirely a struggle for existence[6] on the part of the cells or the individual organs. With advance in evolution this struggle decreases to increase with the opposite procedure of degeneracy. From it result the phenomena of arrested and excessive development. This struggle for existence was very early pointed out by Aristotle,[7] who showed that one organ was often sacrificed for the development of another. This was more clearly pointed out and freed from obscurity by Goethe in 1807 and St. Hilaire in 1818. The law under which this struggle operates is known as the law of economy of growth. Its action sometimes aids, sometimes, when regular, prevents, degeneracy. As has been pointed out by Von Baer, the vertebrate embryo of the higher type has in it all the potentialities for the organs and structures found in lower types. Therefore in proportion as the ancestry is strengthened do these potentialities remain latent. On the other hand, in proportion as the ancestry becomes a subject of nervous exhaustion these potentialities gain nutrition at the expense of the later acquired organs which are the ones likely to be affected by nervous exhaustion. All the organs of the body have practically their own nervous system, which exercises a control over their nutrition through its control over the blood supply and the means of excretion. The excessive action of this local nervous system is regulated by the central nervous system for the benefit of the organism as a whole. Should the central nervous system become weakened, the local nervous system, given free play, first draws greater nourishment and increased

[6] Roux Der Kamp der Theile im Organismus.

[7] Osborn, From the Greeks to Darwin.

power at the expense of other organs. As a result of this increased power the local nervous system becomes itself exhausted and a struggle for existence occurs between its parts. In consequence, as in the case of tumors and cancers, cells take on the power of reproduction, which for a long time they had lost, for the benefit of the organization as a whole.[8] This strugle for existence produces effects which are handed down by heredity or are fought by atavism ("throwback," in the language of the cattle breeders), as the tendency to return to the type of a more remote ancestor is called. It is obvious, therefore, that these two factors in heredity may play beneficial as well as injurious parts on the offspring. As a rule atavism plays a beneficial part in correcting degenerate tendencies. This part may either be complete in the shape of a perfect return to a normal ancestor or may be so incomplete as to moderate in in the offspring the extended nervous exhaustion which an ancestor has transmitted.

As shown by Moreau (de Tours), the biologic effects of degenerative forces on heredity are as follows: First, absence of conception; second, retardation of conception; third, imperfect conception; fourth, incomplete products (monstrosities); fifth, products whose mental, moral and physical constitution is imperfect; sixth, products specially exposed to nervous disorders in order of frequency as follows: Epilepsy, imbecility, idiocy, deaf-mutism, insanity, and other cerebral disorders; seventh, lymphatic products predisposed to tuberculosis and allied disorders; eighth, products which die in infancy in a greater proportion than sound infants under the same conditions; ninth, products which, although they escape the stress of infancy, are less adapted than others to resist disease and death. These varied results are due to the biologic law that, as Herbert Spencer has shown, with increase in growth and specialization must occur decrease in the explosive manifestations of life. Among these explosive manifestations in early biologic history is the function of reproduction which is common to all cells. With advance in evolution the functions of cells become specialized and the extent of reproductive power is decreased. This

[8] Degeneracy, Op. Cit.

specialization, Spencer designates individuation. In degeneracy the organism returns to the lower type and consequently tends to a reversion of individuation. In consequence first occurs the absence of conception to which Moreau de Tours refers. If the organism be less deeply affected, the plural and frequently repeated births of degenerates occur. Abortions are comparatively more frequent in plural than in ordinary pregnancies. Monstrosities of all kinds are commoner in plural than in ordinary pregnancies. There are more dead born children in plural pregnancies, and the children born alive are more difficult to rear. The proportion, according to Ansell,[9] of infants that are still born or die soon after birth is in the case of males nearly five times and in the case of females nearly four times greater in multiple than in single births. Pluriparity, according to J. M. Duncan, is especially associated with idiocy and imbecility, and it especially affects the sterile ages or the ages of weakness of reproduction. According to Arthur Mitchell,[10] among imbeciles and idiots a much larger proportion is found to be twin-born than among the general community. Among relatives of imbeciles and idiots twinning is very frequent. In families where twinning is frequent, bodily deformities (of defect and of excess) likewise occur with frequency. The whole history of twin births is exceptional, indicates imperfect development and feeble organization of the product and tends to show that twinning in man is a departure from the physiologic rule, and hence injurious to all concerned. Everything known concerning triplets and quadruplets supports opinions derived from twins. Valenta had under observation two epileptics (mother and daughter), who illustrated this very decidedly. The mother had thirty-eight children, six times twins, four times triplets and twice quadruplets. The daughter, at the age of forty, had thirty-two children: three times twins, six times triplets and twice quadruplets. Ninety families of degenerates coming under Kiernan's observation[11] averaged eleven children each. Triplets, quadruplets and twins were more than ten times as

[9] Gaillard's Medical Journal, May 12th, 1883.
[10] Medical Times and Gazette, Nov. 15th, 1862.
[11] Alienist and Neurologist, 1901.

frequent as among the population taken as a whole. The ocurrence of large families, as Kiernan remarks, should hence be regarded not as an expression of advance but as an expression of degeneracy. Teachings entirely too prevalent as to status in evolution being determined by progeny have cultivated a factor of degeneracy which, when it occurs in a family, must be regarded as merely a transformation of malign heredity.[12]

From these conflicting factors it results that direct heredity is rare and that acquired influences are apt to expend their force upon unstable structures most subject to the struggle for existence occurring within the organism. The skull, jaws and teeth are predisposed to this struggle and hence peculiarly liable to the ply of hereditary influences or acquired defects of an ancestor.

Heredity hence usually furnishes in the case of the jaws and teeth merely powder to be lighted up by factors locally applied during the periods of stress after birth. Without these locally applied excitants, the types usually ascribed to heredity by dentists will not occur. Environment furnishes the match but it makes a great difference whether, as Havelock Ellis says, the match be thrown into a powder magazine or the sea.

No discussion of heredity is complete without reference to the position of the biologist, Weismann,[13] who (basing his opinion upon an alleged distinction between what he calls the body plasm and the germ plasm), denies the inheritance of acquired defects. An attempt, however, to transfer his position from the domain of biology to that of pathology led him to encounter facts he was obliged to explain in a manner inconsistent with his original position. In his last work,[14] he advances the opinion that "the origin of a variation equally independent of selection and amphimixis is due to the constant occurrence of slight inequalities of nutrition in the germ plasm. These variations are at first infinitesimal but may accumulate, and in fact they must do so when the modified conditions of nutrition which gave rise to them have lasted for several generations. But although it is improbable

[12] Degeneracy, Op. Cit.

[13] Essays upon Heredity.

[14] The Germ Plasm.

that individual variability can depend on a direct action of external influence upon the germ cells and their contained germ plasm must be very difficult to change, yet it is by no means to be implied that this structure may not possibly be altered by influences of the same kind continuing for a very long time. Thus much may be maintained that influences which are mostly of variable nature tending now in one direction, now in another, can hardly produce a change in the structure of the germ plasm, and this is the reason why the cause of inheritable individual difference must be sought elsewhere than in these varying influences." "No one has doubted," he says, in response to Virchow, "that there are a number of congenital deformities, birth-marks and other individual peculiarities which are inherited." But these are acquired characters in the above sense. True, they must have once appeared for the first time, but we cannot say exactly from what cause; we only know that at least a great proportion of them proceed from the germ itself and must therefore be due to alteration of the germinal substance. If Virchow could show that any single one of these hereditary deformities had its origin in the action of some external cause upon the already formed body (soma) of the individual and not upon the germ cell, then the inheritance of acquired characters would be proven. But this no one has yet succeeded in proving, often as it has been maintained. Weismann, however, deals a coup de grace to his own position by admitting that tuberculosis may produce what he calls a "habit in the ancestor which may be transmitted to the descendants. This habit consists in the formation of structural peculiarities such as narrowness of the chest, etc." The admission of such a "habit" offsets any denial of the inheritance of acquired characters. Some recent investigations in the laboratory of the Naples Aquarium[15] have destroyed the embryologic distinction between the germ plasm and the body plasm. Weismann's claim that the first division of the cell represented separation of body plasm and germ plasm is contradicted by these experiments. Not only when the cell has divided twice, but four times and even sixteen times, can the separate cells, if dissociated from the group,

[15] Alienist and Neurologist, July, 1900.

pursue a separate existence and become well developed organisms of the parent type. Experiments in the production of double monsters by E. C. Spitzka, Dareste and others,[16] had long ago cast suspicion upon the embryologic position of Weismann. His criticisms, however, have done undeniable good in destroying loose notions as to direct heredity previously present.

[16] Lectures on Embryology, St. Louis Clinical Record, 1879-1881.

CHAPTER III.

CONGENITAL FACTORS AND MATERNAL IMPRESSIONS.

Hereditary influences must be separated from factors occurring during one pregnancy which affect the product of that pregnancy alone. Prominent among these factors are the "maternal impressions or so-called mother's marks."

A striking illustration of "maternal impressions" among animals was reported nearly two decades ago by T. C. Poole,[1] of Mansfield, Texas. His sow gave birth (April, 1883,) to eight fully developed pigs. The ninth had the appearance of an elephant. It was destitute of hair, had dependent ears, a proboscis, two eyes behind upper two thirds of proboscis, closely approximated, yet distinct, an abnormal superior maxillary, containing three large teeth, with a long, thin upper lip of elephantine shape and color. The sow's gestation lasts three months and twenty days. On Christmas day, 1882, the boar was with her. December 29th, a menagerie had an elephant staked about three hundred yards from where the sow was and in full view.

J. G. Kiernan,[2] commenting on this case, pointed out that the pig, descending from the proboscidæ, has at one stage in intra-uterine development a proboscis whose musculature is still retained by the adult pig, in whom the nose plays to some extent the part of a hand for rooting purposes. The case was, therefore, due to arrested development at the period of pig intra-uterine development when the proboscis existed. This arrested development could have arisen from nervous shock to the sow, alleged since these animals are easily upset during gestation.

Maternal impressions have (as Kiernan remarked in a discussion before the Chicago Academy of Medicine),[3] been considered from one standpoint only and that is as to their supposed cause and its method of action. As the supposed cause is

[1] Gaillard's Medical Journal, Vol. 36, No. 1, 1883.

[2] Gaillard's Medical Journal, July 7th, 1883.

[3] Medicine, May, 1900.

psychic and—in the conception of it usually adopted—immaterial in action, an absurd credulity respecting its powers, which existed at one time among obstetricians, has given way to an equally absurd skepticism. The subject has not been discussed by either set of partisans, from a scientifically critical standpoint. This skeptical spirit has evinced itself in denial of a case authenticated by embryologists and ornithologists of unblemished repute and further supported by teratologic specimens in the British Museum. Spitzka had his skepticism as to maternal impressions shaken by these specimens, which were newly hatched chicks with a curved beak like a parrot and the toe set back as in that bird. The hens in the yard where these monstrosities were hatched had been frightened by a female parrot which, having escaped, fluttered among them before the eggs were laid and greatly frightened the hens from whose eggs the malformed chicks were hatched. This would seem at first sight to confirm the photographic theory of maternal impressions. These malformations are, however, as in the case of the pig, simply arrests of development. Birds are aberrant reptiles belonging to the sauropsidæ, and during their embryonic development pass through a reptilian phase. It was at the end of this phase that the chicks were arrested in development, producing the parrot-like malformation. For lack of logical explanations like these, modern obstetricians are skeptical. In a general way, alleged maternal impressions may be divided into two classes: 1. Those in which an arrest of embryonic development has occurred, which may or may not be traceable to the alleged impression. 2. Photographic impressions charged to a factor utterly incapable of producing them because of the later period in embryonic life at which the impression is alleged to have acted.

The fact that mental shocks can only act on the organization in a purely physical manner is equally ignored by opponents and advocates of the psychic theory of mental impressions. All that is known of the mind is known of it as related to purely physical conditions. It is through pure physical conditions that it must act, whether its action be initiated by conditions affecting physically the various sense organs or not.

There is no doubt that the fœtus is liable to mental effects

from the mother, since, as Féré[4] has shown, it often exhibits very decided reaction to sensory impressions on the mother. Women in the midst of an ordinary dream, producing but very moderate excitations not generally interrupting sleep, are often awakened by fœtal movements. These dreams need have nothing of the nightmare which would cause sudden contraction under the influence of a terrifying idea with its resultant cardiac disorder. They may be merely the ordinary phenomena of sleep. Mental changes of the mother hence excite motor reaction in the fœtus and, as with sensorial excitations, these reactions are stronger in the fœtus than in the mother. The mechanism c these motor reactions is obviously the unconscious and involuntary movement of the uterine walls. A. Lagorio,[5] some seventeen years ago, brought before the Chicago Medical Society several cases in which maternal impressions had produced decidedly abnormal births with deformities resembling those feared by the mother. In discussing these Kiernan pointed out that they were all instances of checked development and advanced the opinion that normal shock generally played the chief part in maternal impressions through checking development and causing either general or local reversion. Here the statistic method can be applied. Of 92 children born in Paris during its last seige, 64 had slight mental or physical anomalies. The remaining 28 were all weakly; 21 were imbecile or idiotic and 8 were morally insane. These figures of Legrande du Saulle justify the characterization by the working class of Paris of children born in 1871 as "doomed children." In Berlin the financial crisis of 1875-1880 was followed by an increase in the number of idiots born. It must be remembered that profound mental shock can alter nutrition so that the mother shall furnish poisonous products in lieu of nutriment. That such poisonous products would tend to check fœtal development no one will deny.

Therefore, while science rejects the photographic phase of maternal impressions, it admits that a class of cases of arrested

[4] Sensation et Mouvement.

[5] Chicago Medical Journal and Examiner, 1883-84.

development exists, due to the effects of mental shock upon the mother.

The influence of maternal impressions would be most strongly exerted on structures variable in evolution. This influence must, hence, strongly affect nutrition of the dermal bone elements of the skull, face and jaws, and hence must affect the teeth. The results of this will not always be obvious until the periods of stress.

One expression of fœtal senescence is the production of children born with teeth. This often occurs, however, under the law of economy of growth in connection with arrested development elsewhere. Cyclops and similar grave types of degeneracy are frequently accompanied with premature eruption or development of the teeth. The connection between degeneracy and teeth at birth must have been very early observed, since Shakespeare makes Richard III remark,

"The midwife wonder'd and the woman cried,
'O Jesu, bless us, he is born with teeth,
And so I was; which plainly signified
That I should snarl and bite and play the dog."

Ante-natal teeth are far from rare and as Gould[6] remarks, the significance of such eruption of teeth is not always that of vigor, since many of the subjects succumb early in life. Pliny, Columbus, Van Swieten, Haller, Marcellus Donatus, Baudeloque, Cazeaux, Soemmering and Gardien cite instances in which children have been born with teeth already erupted. Haller has collected 19 cases of children born with teeth. Polyderus Virgilus describes an infant who was born with six teeth. Louis XIV had two teeth at birth. Bigot, a medical philosopher of the sixteenth century, Boyd the poet, Valerian, as well as some ancient Greeks and Romans, had this anomaly. There were two cases typical of fœtal dentition shown before the Academie de Médecine de Paris. One of the subjects had two central incisors of the lower jaw and the other had one tooth well through. Levison saw a female born with two central incisors in the lower jaw.

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[6] Anomalies.

CHAPTER IV.

POST-NATAL SKULL AND JAW DEVELOPMENT AND PERIODS OF STRESS.

The assumption that the child is simply an immature man or woman is, as has been shown by biologists, a far too prevalent error. The child, with its relatively enormous head, its large protuberant abdomen—"all brain and belly," as some one defines it—its small chest, short, feeble legs, comparatively vigorous arms, smooth, almost hairless skin, large liver, kidneys, thymus and suprarenal capsules presents, as Havelock Ellis[1] remarks, a distinct anatomic picture. The facts of the child's physiologic and psychic life are clear indications in the same direction. The anthropoid apes at an early period of life often present characters quite unlike those of the adult. While the young anthropoid is comparatively human, the adult ape is comparatively bestial in character. The young ape has a smooth globular head and relatively small face, like man. The profile is more human with little prognathism. The base of the skull is formed in a more human way than in the adult ape. The brain is relatively very much larger than in the adult. In the gorilla, for example, the fœtus differs from the adult by having relatively a much larger head, a longer neck, a more slender trunk, shorter thumb and great toe; while the head is more globular, the face less prognathous and the hand more man like. In nearly all these characters, the fœtal gorilla approaches man. The adult male ape rapidly develops into a condition far removed from his early man-like state. The brain becomes relatively very small, the receding skull becomes hideous with huge bony crests, sharp angles and on its enormously enlarged facial portions, prominent outstanding superciliary ridges, projecting jaws and receding chin, while the dark hairy body becomes more bestial in character. The female ape remains midway between the infantile and the adult male condition. So far as man is ape-like it is the infantile and not the adult whom he resembles. Man in

[1] Man and Woman.

the course of his life falls away more and more from the specifically human type of his early years, but the ape in the course of his short life goes very much farther along the road of degradation and premature senility. The ape starts in life with a considerable human endowment, but in the course of life falls far away from it. Man starts in life with a still greater portion of human or ultra human endowment and to a less extent falls from it in adult life, approaching more and more to the ape. Up to birth or shortly afterwards in the higher animals, such as the apes and man, there is a rapid and vigorous movement along the line upward in zoologic evolution. A time comes, however, when this fœtal or infantile development, ceasing to be upward, is so directed as to answer to the life wants of the particular species. Henceforth and throughout life there is chiefly a development of lower characters, a slow movement towards degeneration and senility, although one absolutely necessary to insure the preservation and stability of the individual and species.

Fœtal evolution, which takes place sheltered from the world, is in an abstractly upward direction. After birth further development is a concrete adaptation to the environment without regard to upward zoologic movement. The infantile condition in both ape and man is somewhat alike and approximates to the human condition. The adult condition of both also tends to be somewhat alike and approximates to the ape-like condition.

The human infant presents in an exaggerated form the chief distinctive characteristics of humanity, the large head and brain, the small face, the hairlessness, the delicate bony system. By some strange confusion of thought, this fact is usually ignored and it is assumed that the adult form is more highly developed than the infantile form. From the standpoint of adaption to environment, the coarse, hairy, large-boned and small-brained gorilla is better fitted to make his way in the world than the delicate offspring, but from a zoologic point of view anything but progress occurs. In man, from about the third year onward, further growth, though absolutely necessary adaption to the environment, is to some extent growth in degeneration and senility. It is not carried to so low a degree as in the apes, although by it man is to some extent brought nearer to the apes. Among the higher human races the progress toward senility is less

marked than among the lower human races. The child of many African races is scarcely, if at all, less intelligent than the European child. The African, as he grows up, however, becomes stupid and obtuse and his whole social life falls into a state of hide-bound routine. The European retains much of his child-

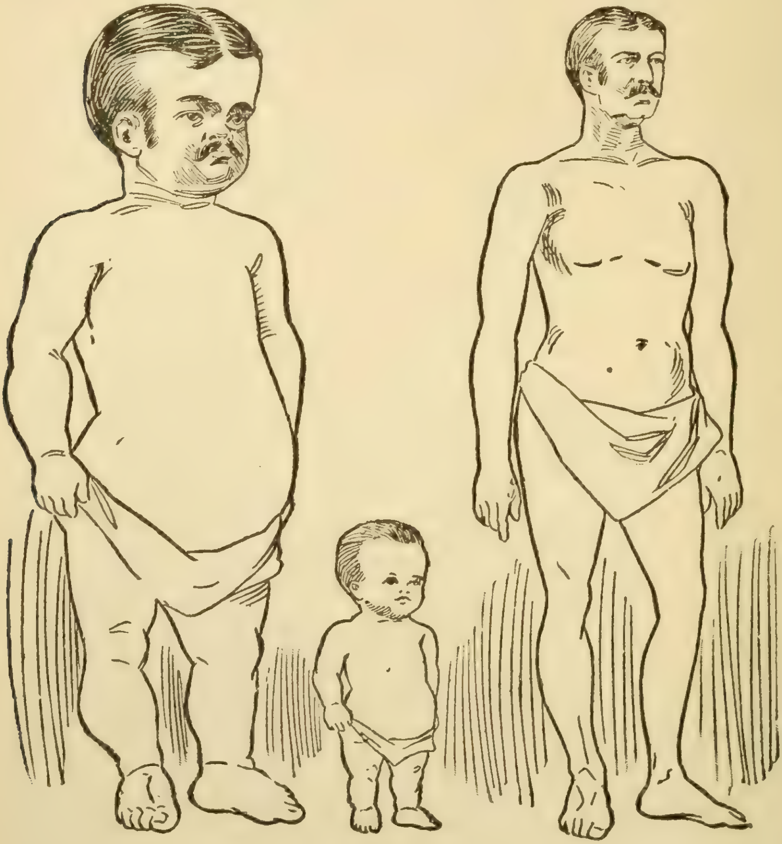

Fig. 1.

like vivacity. The highest human types represented in typical men of genius are a striking approximation to the child type.

The contrast between the prophecy of development in the child and its fulfillment in the adult is excellently depicted in the above illustration (Fig. 1) modified from Havelock Ellis.[2]

[2] Man and Woman.

The great factors in the environment which interrupt race upward progress are as Kiernan[3] points out, the periods of stress. While even the last of these presents as its most obvious feature dentitional evidences, still in all, important processes of nutrition and reproduction are involved.

Every vertebrate, as I pointed out some years ago,[4] is an aggregate whose internal actions are adapted to counterbalance its external actions. Hence preservation of its movable equilibrium depends upon its development and the proper number of these actions. The movable equilibrium may be ruined when one of these actions is too great or too small and through deficiency or need of some organic or inorganic cause in its surroundings. Every individual can adapt itself to these changeable influences in two ways, either directly or by producing new individuals who will take the place of those in whom the equilibrium has been destroyed. Therefore, forces exist preservative and destructive to the race. Since it is impossible that these two varieties of force should counterbalance each other, it is necessary that the equilibrium should re-establish itself in an orderly way. Since these are two preservative forces of every animal group—the impulse of every individual to self-preservation and the impulse to the production to other individuals—these faculties must vary in an inverse ratio and the former must diminish when the second increases. Degeneration constitutes a process of disintegration. Hence if the term "individuation" be applied to all the processes which complete and sustain the life of the individual, and that of "generation," to those which aid the formation and development of new individuals. Individuation and generation are necessarily antagonistic, as Herbert Spencer[5] has shown.

Vertebrate embryos, all of common type at their origin, assume, as Von Baer has demonstrated successively, a number of common forms before definitely differentiating. Supernumerary organs, as Dareste has shown, exist in these common forms at one phase of embryonic life. This community of embryonic

[3] Child Study Magazine, 1898.
[4] Degeneracy, Op. Cit.
[5] Principles of Biology.

types and this last fact, explains repetition of teratologic types in vertebrates. This community of origin, moreover, indicates that the higher vertebrate embryo contains in essence the organs and potentialities of all the lower vertebrates, and that under the influence of heredity or accidental defect an organ or structure or function constant in a species may be lacking in an individual without the necessity of explaining the immediate effects by distant atavism.

Varying conditions must stimulate these embryologic potentialities at the expense of the later acquired and more typic human organs. The Cohnheim theory of cancer is an application of this principle.[6] From this results a struggle for existence on the part of organs and structures which, early observed by Aristotle, Goethe and St. Hilaire, was forcibly shown by Roux[7] two decades ago, who, while admitting determination by heredity, pointed out that there are always surrounding forces necessary, not simply the condition of activity by an essential element of the final product. He thus harmonizes the extreme views by an internal or physiologic struggle for existence between the organs, the cells and protoplasmic molecules of the organism. This unsimilarity of parts makes it impossible to establish laws of heredity which shall govern details of function as to the last cell or molecule since in any army the commander-in-chief does not give a special order beforehand affecting every private in the ranks. There must be potentiality of adaptation to surroundings, especially in details, which are more easily changed than events on a larger scale.

The principle that lies back of all development of tissues and organs is over compensation of what is used, a quality which permits self-regulation and is rarely a necessary precondition of life. Living matter presents an external continuity in spite of change of condition. To effect this, assimilation must always be in excess (over-stimulation) for if less than consumption, the organism comes to an end itself. If equal conditions result, change and nourishment will fail or injurious events will cause

[6] Kiernan (Editorial Journal of American Medical Association, Vol. XXXI).

[7] Op. Cit.

destruction. Continuance can only be assured when more is assimilated than is consumed. Fire, for example, assimilates more than it uses, i. e., it always has energy left over to kindle new material. Fire would, like life, become external if it did not use up material quicker than other processes can make them. In the same way organisms assimilate more than they can consume, but they do not turn all they use to assimilation; energy remains over by which the process performs some thing. This work product controls the excessive assimilation which otherwise would come to an end by not having sufficient material to assimilate. The more complex processes of life are, hence, essentially as Colin A. Scott[8] remarks, a radiation of assimilation which, although not identical with combustion, is similar to it; the load which it carries favoring its continuity. This radiation, load or over product becomes directed by natural selection to keep up a supply of food primarily by moving the assimilating mass. Performance of function over and above assimilation is just as much a condition of continuous assimilation as assimilation is of performance. On the other hand, there comes to be an inverse relationship between growth and product (within limits) and capacities result which, although they use up material, do not in themselves increase assimilation. The course of development consists in properly directing the work products. This so far represents merely a continuous productibility of function in connection with assimilation. But a productibility which is stored up and discharged by an outer stimulus of environment will be much more economic and will give rise to what we find as reflex excitability. When this reflex product dominates, according to circumstances, function will sometimes be greater and sometimes less. If, under these conditions, assimilation keeps on continuously, there must sometimes be an overplus, sometimes a balance and sometimes an excessive function, death and thus elimination. To avoid this last, it is necessary that assimilation should depend upon use or upon a stimulus, which use calls forth. From the psychic side stimulus is recognized as hunger.

This kind of process where stimulus is an indispensable factor is more special and limited than the more general process of

[8] American Psychological Journal, 1888.

assimilation plus movement, etc., but has characteristics which favor it greatly in the struggle for existence. Connected with the most complete self-regulation of functionation is the greatest saving of material. While those parts, according to their use, are strengthened and grow, the unused degenerate and the material for their substance is saved. This kind of process unites the greatest economy with the highest functioning of the whole, but at the cost of the independence of the parts. Senescence becomes thus a result in differentiation in which the parts exist merely on account of the function which they perform for the whole. The senescing organs wither and may even descend in this condition from generation to generation, a fact which often allows a fresh start in development. During the course of lifetime the organism moves from a more general, more easily impressible condition to one more perfectly mechanized. Through a long period it becomes, through the continuous working of a given stimulus, more completely adapted to itself and also more differentiated and thereby more stable, so that an always increasing opposition is formed to the additional development of new forms and characteristics. The principle, known as the law of economy of growth, holds good of man, as Dohrn[9] has shown, not only as an organic unit but as a compound organism. It has been lately extended to sociology by DeMoor.[10]

Degeneracy, according to Ray Lankester,[11] is a gradual change of structures by which the organism becomes adapted to less varied and complex conditions of life. The opposite progressive process of elaboration is a gradual change of structure by which the organism becomes adapted to more varied and complex conditions of existence. In elaboration, there is a new expression of form corresponding to new perfection of work in the animal machine. In degeneracy there is a suppression of form corresponding to the cessation of work. Elaboration of some one organ may be a necessary accompaniment of degeneracy in all others. This is very generally the case. Only when the total result of the elaboration of some organs and the

[9] Osborn, From the Greeks to Darwin.
[10] Evolution by Atrophy.
[11] Degeneration.

degeneracy of others is such as to leave the whole mass in a lower condition, that is fitted to less complex action and reaction in regard to its surroundings than is the type, can the individual be regarded as an instance of degeneracy.

As Harriet Alexander[12] has shown, since degeneracy is a process of evolution, leading to alteration of form because of cessation of inhibitions in certain directions resultant on diminished work, it logically follows that since diminished functioning precedes change of structure increased functioning must check the change of structure in its biochemic stage. Nay, more, it is evident that structural elaboration due to degeneracy may be retained while the degenerate structures resume their higher functions. Hence the degenerate race ranks higher in evolution because of the utilization of the beneficial variations due to degeneracy. The influence of this principle is increased by the fact that the majority of the children of degenerates inherit a tendency to degeneracy rather than degeneracy itself.

Since, as Kiernan[13] points out, certain parts may disappear in the evolution of organs and certain organs during the evolution of organisms and since the disappearance and developing tendency must center around the time when certain functions will be lost by the disappearing and others gained by the developing periods of stress must occur, around which the law of economy of growth will center, the struggle for existence between the parts of organs and between the organs. Struggles for existence on the part of the different organs and systems of the body are hence most ardent during the periods of intra and extra-uterine evolution and involution. During the first dentition, during the second dentition (often as late as the thirteenth year), during puberty and adolescence (fourteen to twenty-five), during the climacteric (forty to sixty), when uterine involution occurs in woman and prostatic involution in man, and finally during senility (sixty and upwards), mental or physical defect may, as I have elsewhere shown, occur a congenital tendency to which has remained latent until the period of stress.

When systemic balance, the result of evolution, is disturbed

[12] Medicine, 1896.

[13] Medicine, 1901.

by change in environment, the organs, as has been shown experimentally by Jacques Loeb,[14] do not pursue their usual growth. Such disturbances are peculiarly apt to occur during periods of stress because of the then varying relations of different organs.

During the first extra-uterine period of stress, between birth and three months, the brain is one-fifth the weight of the body, while in the adult it is but one-thirty-third. During the first six months the brain doubles in weight. The effects of stress during this period would, under the law of economy of growth, either be felt in diminution of the quality or quantity of the brain or in the preservation of these at the expense of more transitory structures. Here the teeth, alveolar process and jaws would be affected. During the period between two years and six the same factors to a lesser degree are present, while between seven and fourteen the brain has quadrupled in weight. At birth the heart is small relatively to the arterial system, but this disproportion gradually disappears until at puberty, when, according to Beneke, the relation is changed. The larger the heart relatively to the vessels the higher the blood pressure and the earlier, stronger and more complete is the development of puberty. The weight of the heart from birth onwards, increases twelve and a half times. During this period, strain interfering with heart growth would either affect it or under the law of economy of growth, the more transitory structures for its benefit.

To a certain extent, as DeMoor[15] remarks, periods of stress resemble ancestral stages. Moreover, when there is a recapitulation of ancestral stages it often happens that evolution takes place without leaving traces of the various stages. This is especially the case in complex organs which have been produced by many lines of evolution converging in a single structure—a structure which thus becomes the seat of a special function or set of functions.

The neuron, for instance, the ganglionic cell of the cortex of the human brain, passes successively through stages corresponding to those which are to be found in the adult fish, frog, bird and mammal. Here development consists in an increasing

[14] Untersuch. zur Physiol. Morphologie.

[15] Evolution by Atrophy.

complexity of the cell with no formation of unnecessary rudimentary parts. This is also the case when the development of the brain of man is compared with the probable ancestral stages as displayed in the vertebrate series.

In Fish and Batrachia	The cerebral hemispheres do not cover the region of the third ventricle (Thalamencephalon) from which the eyes arise.	In the human embryo of the seventh week.	Same aspects.
In Reptiles	The hemispheres cover the thalamencephalon but leave uncovered the region of the optics lobes (mesencephalon).	In the human embryo of the middle of the third month.	Same aspect.
In Mammals	The hemispheres cover the thalamencephalon, the mesencephalon, sometimes the metencephalon (cerebellum and medulla), and the olfactory lobes.	In the human embryo of the fifth month.	Same aspect.
In the same mammals even of higher orders (e. g., some Hapalidae).	The hemispheres are smooth.	In the human embryo of the middle of the fifth month.	Same aspect.

CHAPTER V.

DEVELOPMENT OF THE CRANIUM AND FACE.

The human skull has a double origin. There are really two skulls (one inside the other). These were originally distinct, but in the process of evolution the union between them became more and more intimate. This development is summed up in the changes which embryologically occur in man.[1] The primary skull, as I have elsewhere pointed out,[2] is practically an extension of the vertebræ, which send out sidegrowths to cover the brain as the backbone covers the spinal cord. The primary skull extends in front of the notchord (the spinal cord of the human embryo and the permanent spinal cord of the lancelet), where it gives off two trabeculæ cranii (front skull plates). Behind, the primary skull or chondrocranium gives off two occipital or rear skull plates. It also gives off two plates (midway between the trabeculæ and occipitals), which, as they gradually enclose the primitive hearing apparatus (the otocysts, permanent in fish and embryonic in man), are called periotic capsules. This primary skull is at first cartilaginous, as in sharks. With increase in the size of the brain in evolution and in human embryolgeny this cartilaginous primary skull becomes insufficient to roof over the brain and thus produces the gaps called fontanelles (or soft places at the top, sides and back of the head of the new born child). These are the results of this failure of the chondrocranium (primary skull) to cover the gains of the nervous system in the struggle for existence. This deficiency, resultant on advance in evolution, would have been a long-standing serious block to further advance were it not that the skin of the mammal retained a bone-making function inherited from the reptiles and bony fish.

These cavities were filled with dermal bones which, at first serving merely as armor in the skin of the head, came ultimately

[1] Minot Embryology, pages 465-467.

[2] Degeneracy Op. Cit.

to be protectors of the nervous system. The following bones represent these dermal bones in the embryonic human skull: The frontals, whose sutures normally disappear in the adult so that the forehead seems to be but one bone. This union may not occur, when as in the case of the philosopher Kant, the frontal suture remains during life. The sutures are replaced by solid bone through synostosis. In the frontal bone, synostosis is normal and in the line of advance. Elsewhere in the skull it is often an expression of a premature senility that may give rise to various cranial states either absolutely degenerate in type or degenerate only when present in certain races. The parietals and interparietals are dermal bones so united by synostosis as to form the parietals or side bones of the normal adult skull. The nasal bones, which, together with the vomer, form the nose, are likewise dermal bones and so are the pterygoids and palatines. The maxillaries and præmaxillaries, which (with the mandibles) form the jaws are dermal bones. The mandibles are in part derived from the chondrocranium.

Owing to the head bend of the embryo the mouth cavity, as Minot remarks, is brought between the forebrain and the heart and upon the ventral surface. The development of the face depends upon the enlargement and fusion of the mouth and nose cavities, and upon the later partial separation of the nose and mouth and nose cavities, leaving the posterior nose open. It depends further upon the growth and specialization of the face region, of which elongation is the most prominent indication, and finally upon the development of a prominent external nose. When the medullary tube of the notochord enlarges to form the brain, the end of the head bends over to make room for that enlargement. The bending of the head carries the mouth plate (which is to be the mouth) over to the front of the head. Two changes which develop the mouth cavity are the growth of the brain and the increase in size of the heart cavity, which expand to the front, leaving the mouth cavity between them. The mouth cavity represents two gill-slitts united in the front line. The nose is formed from two olfactory plates situated just in front of the mouth and in contact with the forebrain. These olfactory plates grow in size by the increase of tissue and the resulting

pits pass away from the brain. At first these pits (although widely separated by what is called the nasal process) communicate freely with the mouth. The nasal process includes the origin of the future nose and of the future intermaxillary region of the upper lip.

The nasal pits proper are developed by the upgrowth of the ectoderm and mesoderm, around the olfactory plate. The upgrowth takes place on the medial, upper and lateral side of each plate, and hence forms two pits with a partition (the future nasal septum) between them. These nasal pits communicate along their whole lower side directly with the mouth cavity. The nasal pit is at first very shallow. In their growth there are two principal changes: First, growth of the tissues occurs around the olfactory plate, and then the pits migrate away from the brain. The nasal pits are separated by a projecting mass of tissue called the nasal process, which includes the partition between the two nasal chambers, the outline of the future nose and of the future intermaxillary region of the upper lip. The maxillary process extends between the mouth and eye toward the nasal pit and by joining the rounded end of the nasal process begins the separation of the nasal and buccal chambers and completes the upper border of the mouth. As development proceeds, the lateral ridge grows forward and covers in the nasal pit from the side forming the outline of the wing of the adult nose. There are now two external nares. The nasal chambers enlarge as the whole face enlarges and occupy an increasing space opening widely into the mouth cavity above the palate shelf. It is from the nasal pit proper that the so-called labyrinth of the nose is formed. The development of the labyrinth begins with the appearance (during the third month of embryonic life) of three projecting folds on the lateral wall of each nasal chamber. These folds are the upper, middle and lower turbinal folds. They very early contain cartilage. The formation of labyrinth advances by formation of outgrowths, which become the ethmoidal sinuses, by the appearance during the sixth month of the antrum Highmorii or expansion of the nasal cavity into the region of the superior maxillary and finally by evaginations to form the sphenoidal and frontal sinuses, which, however, do not

arise in man until after birth. The separation of the olfactory plate from the brain does not take place until the olfactory ganglion develops from the epithelium. The fibers lengthen, the olfactory and neural epithelium separate and finally the osseous cribriform plate is developed between them.

The external nose develops toward the end of the second month of embryonic life by a growth of the nasal process. It is at first short and broad, having (at the third month of embryonic life) very nearly the shape which is permanent in certain negro races. The external nares and wings of the nose are carried forward with a general nasal upgrowth.

As soon as the external nose is separated from the mouth there is a partition between the nasal pits and the mouth. The partition in which the intermaxillary bone is differentiated later, is supplemented by another partition, the true palate, which shuts off the upper part of the mouth cavity from the lower, thus adding the upper part to the nose chambers. The palate is a secondary structure which divides the mouth into an upper respiratory passage and a lower lingual or digestive classes. The palate arises as two shelf-like growths of the inner side of each maxillary process, and is completed by the union of the two shelves in the median line. These so arch as to descend a certain distance into the pharynx. In the pharynx, however, their growth is arrested, though they may be still recognized in the adult. In the region of the tongue, which includes more than the primitive mouth cavity, the palate shelves continue growing. At first they project obliquely downward toward the floor of the mouth and the tongue rising between them seems in sections, which pass through the internal nares, to be about to join the internasal septum. As the lower jaw grows, the floor of the mouth is lowered and the tongue is thus brought further away from the internasal septum. At the same time the palate shelves take a more horizontal position and pass toward one another above the tongue and below the nasal septum to meet in the middle line, where they unite. From their original position the shelves necessarily meet in front toward the lip first, and unite behind toward the pharynx later. In the human embryo, union begins at eight weeks and by nine weeks is completed for the

region of the future hard palate and by eleven weeks for soft also. The palate shelves extend back across the second and third branchial arches. The uvula appears during the latter half of the third month as a projection of the border of the soft palate. Soon after the palatal shelves have united with one another, the nasal septum unites with the palate also, and thereby the permanent or adult relations of the cavities are established.

The fact that the human face is modified backward from the vertebrate type excellently illustrates the degeneracy of a series of related structures for the benefit of the organism as a whole. The progress of development of the vertebral face is checked in man because, as Minot remarks, the upright position renders it unnecessary to bend the head as in quadrupeds, and because the enormous cerebral development has rendered an enlargement of the brain cavity necessary. This has taken place by extending the cavity over the nose region as well as by enlarging the whole skull. Third, because development of the face is arrested at an embryonic stage. The production of a long snout is really an advance of development, which does not occur in man.

Upon variations in the dermal bones depend not only the race variations in skull and jaw types but also the variations produced by agencies acting on the individual during the periods of bodily stress and by the degenerative influences.

Craniologists generally assume two fundamental skull types, dolichocephalous or long horizontally, that is, from back to front, and the brachycephalous or approximately round horizontally. The types are determined by the so-called cephalic index, which is determined by the relation of the antero-posterior diameter (measured from the glabella to the farthest point of the occiput) to the transverse diameter from side to side.[3] The former being taken at 100, the latter will range from about 60 to 95 or even more, increasing with the greater degree of brachycephaly and vice versa. Excluding artificial deformation, the extremes appear to lie between 61'9 (Fijian, measured by Flower) and 98.21 (a Mongolian, described by Huxley). This last approaches the perfect circle, which is never presented by the normal head,

[3] Keane Ethnology.

though exceeded (103-105) by pathologic, teratologic or deformed specimens. Most peoples are now mesaticephalous and hence of mixed descent. This race intermingling began in neolithic times. Speaking broadly, the horizontal index is now applicable less to the primary than to the secondary divisions of mankind. The alleged normal dolichocephaly of African Negroes has numerous exceptions. The Eskimo, who seemingly ought to be brachycephalic are extremely dolichocephalic.

To meet the endless transitions between the two extremes Broca proposed the following five-fold division:

1. Dolichocephali .... with index No. 75 and under.
2. Sub-dolichocephali .... with index No. 75.10 to 77.77.
3. Mesaticephali .... with index No. 77.78 to 80.
4. Sub-brachycephali .... with index No. 80.10 to 83.83.
5. Brachycephali .... with index No. 83.34 upwards.

Under this classification races may be ranged thus:

1. DOLICHOCEPHALI.

Kai-Colo (mean)	65	Neanderthal	72(?)
Australian	71.49	Hottentot and Bushman	72.43
Eskimo (Greenlander)	71.77	Kaffir	72.54
W. African Negro	73.40	Low-Caste Calcutta	74.17
Cro-Magnon	73.34	Berber	74.63
Nile Nubian	73.72	Langerie Basse	74.85
Algerian Arab	74.06	Baumes Chaudes (Lozero)	75

2. SUB-DOLICHOCEPHALI.

Dolmens N. of Paris	75.01	Anglo-Saxon	76.10
Guanches (Canaries)	75.53	Polynesians (some)	76.30
Old Egyptians	75.78	Copts (Modern Egyptians)	76.39
Ainus (some)	76	Basques of Guipuzcoa	77.62
Tasmanians	76.11	Chinese	77.60

3. MESATICEPHALI.

Ancient Gauls	78.09	Hawaiians	80.0
Mexicans (normal)	78.12	Afghans	79 to 80
Dutch	78.89	Ossetians	80.0
Prussians	78.90	Petit Morin (Marne and others from Neolithic caves and dolmens	80.0
S. Americans	79.16		
N. Americans	79.25		

4. SUB-BRACHYCEPHALI.

French Basques	80.25	Italians (North)	81.80
Low Bretons	81.25	Andamanese	81.87
Mongols (various)	81.40	Finns	82.0
Turks (various)	81.49	Little Russians	82.03
Javanese	81.61	Germans (South)	83.0

5. BRACHYCEPHALI.

Indo-Chinese	83.51	Burmese	86
Savoyards	83.63	Armenians	86.5
Croatians	84.83	Solutre	88.26
Bavarians	84.87	Peruvians	93.0
Lapps	85.07	Huxley's Mongol	98.21

Some value has been attached to the vertical index (high and broad) which, when it rises to or exceeds 100 determines the so-called hypsistenocephaly characteristic of the Maliclos and other Melanesians.

No cranial measurement is more important than that which determines the varying gnathism or greater or less projection of the upper jaw, which depends upon the angle made by the whole face with the brain cap. The more obtuse the angle the greater will be the maxillary projection (Prognathism), the more vertical the face the less the projection (Orthognathism): Hence gnathism (best seen in profile) as indicated by the facial angle, is accepted by anthropologists as a race criterion. Its evolution (intimately associated with the dentition and change from raw to cooked food) has been from the extreme projection of the higher apes and of primitive man to the seemingly vertical position of the Mongolic and Caucasic groups. Prognathism is, hence, characteristic of the lower orthognathism of the higher races. The profile of the Calmuck face is almost vertical, the facial bones being thrown downwards and under the forepart of the skull. The profile of the face of the negro is differently inclined; the front part of the jaws projecting far forward beyond the level of the fore part of the skull. In the former the skull is orthognathous or straight-jawed, in the latter it is prognathous.

Combining this feature with eurygnathism (that is lateral projection of the cheek bones) Geoffrey Saint-Hilaire found that the Caucasic face is oval with vertical jaws, the Mongolic broad

(eurygnathous), the Negro prognathous and the Hottentot both pro- and eurygnathous.

Topinard distinguishes between a superior and anterior facial angle. The former (general facial gnathism) is fallacious as a guide. The latter (that is sub-nasal gnathism) being trustworthy. Anthropologists have erred in giving so much importance to the projection of the whole maxilla or of the whole face. There is no uniformity of results in any given series. The most flagrant contradictions occur between averages in allied races. Sub-nasal or true prognathism, however, furnishes of itself the differential character of the various human types. Subnasal gnathism is determined by the angle formed by a line drawn from the nasal spine (sub-nasal point) to the anterior extremity of the alveolo-condylean plane. This plane, which gives the total projection of the skull, is about parallel with the horizontal line of vision coinciding with a line drawn from the alveolar point (medium point of the alveolar arch) at right angles to a perpendicular falling from the occipital condyles. Topinard has had the following results:

TRUE OR SUB-NASAL PROGNATHISM.

Individual extremes	89 to 51.3	Merovingians	76.54
White races	82 to 76.5	Finns and Esthonians	75.53
Yellow races	76 to 68.5	Tasmanians	75.28
Black races	69 to 59.5	Tahitians	75
Gaunches	81.34	Chinese	72
Corsicans	81.28	Eskimo	71.46
Gauls	80.87	Malays	69.49
Dead Man's Cave	79.77	New Caledonians	69.87
Parisians	78.12	Australians	68.24
Toulousians	78.5	W. African Negro	66.91
Auvergnats	77.18	Namaquas and Bushmen	59.58

From this it is evident that absolute orthognathism does not exist. All races are more or less prognathous, the European least, the Negro most, the Mongol and Polynesian intermediate. In Europe the most orthognathous were the Gauls, Corsicans and Neolithic men. The Finns were the least. Orthognathism, as the term is used in anthropology, simply applies to the subnasal type of gnathism. In teratology, the relation of the inferior maxilla must likewise be taken into consideration, since around this turns the struggle for existence between the jaws and teeth.

CHAPTER VI.

DEVELOPMENT OF THE JAWS.

The vertebrate mouth belongs primitively on the under side of the head and is at first a simple transversely expanded orifice. The position of the face or oral region is, as already shown, originally determined by the head bend. The embryologic relationships of the mouth area and the hypophysis already cited serve to explain why constitutional disorders and infectious disease influence growth and development of the maxillæ, especially the lower. The changes about the face so common and characteristic of acromegaly are extreme illustrations of this.

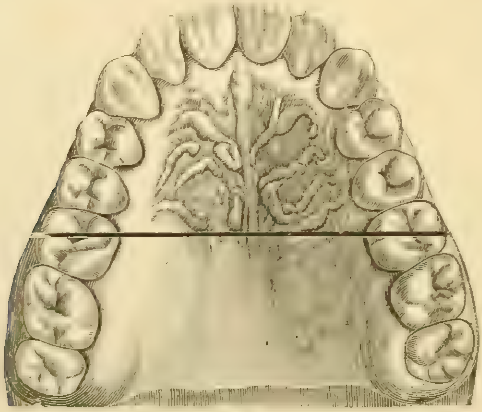

Fig. 2.

To determine the nature of the evolution resultant on these influences and others found in the jaws of modern races, I made numerous measurements (Table I) anent these changes. The measurements of early as well as modern peoples were made on skulls obtained from the museums and crypts of churches in Europe, in which last large collections of skulls are found.

Measurements were made across the upper jaw from the outer surface of one first molar to the outer surface of the corresponding molar of the other side (Fig. 2). These points were

taken because these molars are first of the permanent set to develop, hence because developing posterior to the temporary ones, they erupt independently and are not interfered with by any in the jaw. The point of the jaw where these teeth are situated is the widest normally developed not influenced by local causes. This furthermore was most accessible. Measurements were made in persons over twenty-five years of age, because at or near this period growth is complete. After this period development is very slow. At thirty to thirty-five years it ceases altogether.

From analysis of these measurements of crania and living individuals, which have extended over years, the human jaw is clearly diminishing in size as the usual control experiments were made to eliminate error.

Differences in measurements of the antero-posterior and lateral diameter resulted since in many cases the antero-posterior diameter was taken from the first and second molars instead of from the third. All such measurements were rejected.

Diameter of the jaw, hence, depends to a great extent upon size of the skeleton. A small person usually has a small jaw, a large person a large jaw. Exceptions, however, occur. Small people with large jaws and large people with small jaws are frequently observed in limestone countries, from resultant excessive or arrested development of the maxillæ. Marked sexual differences occur. Difference (ranging from .02 to .16 of an inch) occurs in living individuals and in ancient races.

The lateral diameter of jaws of existent races in Europe is greater than of the same races in America. The jaws of American Indians are much larger than jaws of American Europeans. The jaws in older parts of the United States are smaller than jaws in the newer. The differences between jaws of the residents of Boston and those of Chicago are thus in evidence.

Marked differences usually exist between jaws of dispensary and charity patients and jaws of the wealthier classes.

In Chinese jaws the range is only from 2 to 2.44, with one measurement at 2.52; peoples of India, 1.94 to 2.37; Negro, 2.07 to 2.50; Marshpee Indians, 2 to 2.50. In Swedes the range is from 1.88 to 2.63, and in the Danish colony, Dublin, from 1.88

to 2.50; in London, from 1.88 to 2.44, while the range of the white people in America is from 1.75 to 2.63. The diminution of the jaws is evident on comparison of measurement of the jaws of the same peoples at different periods of culture. The jaws of primitive races are larger than those of the civilized.

In most cases, size and shape of the jaws are commensurate with the osseous structure of the individual. Bushmen (small in stature) present the smallest range in the size of the jaws—2.12 to 2.37 inches.

The range of ancient races is 2.12 to 2.62 inches, while that of modern is 2.12 to 2.87 inches. Only three modern races,

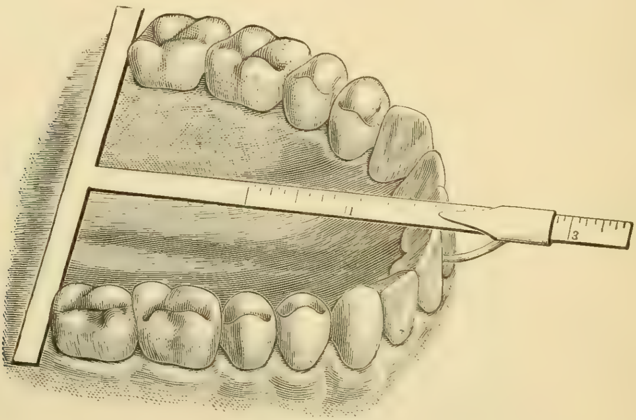

Fig. 3.

however, have a minimum of 2.12, while the minimum of all ancient races is 2.12 inches. The maximum of ancient races is less than that of the modern.

The anterior posterior diameter is from the alveolar process at a point between the central incisors extending backward in the median line and meeting a line drawn at right angles to the posterior surface of the third molar (Fig. 3).

The principle holds good for the development of the antero-posterior diameter as laid down for the lateral diameter. The antero-posterior diameter of the jaws of the female is less than that of the male by from .02 to .24 of an inch. This disparity compared with that of the lateral diameter is a natural one. After

temporary teeth are all in place natural development of the jaw is in an antero-posterior direction. The changes in evolution of the face and jaws consist of shortening of the antero-posterior diameter. Marked differences arise often from the entire arrest of development of the posterior part of the body of the jaw. This always occurs when permanent molars have been extracted, allowing the third molar to come forward, or when the individual has inherited the large jaws of one parent and the small teeth of the other parent, or when the jaws have become arrested in development. In comparing antero-posterior diameter of the jaws of one people with those of another skull characters must be taken into consideration. In brachycephaly occurs the broad jaw and in dolichocephaly the long jaw. This difference occurs chiefly in relatively pure races. It is evident by comparing external condition of the head and skull with the jaws. No type of skull could be determined from examination of a thousand plaster casts of the mouth of mixed classes of people. Local conditions often modify the shape of the jaw of mixed races. Correlation between the shape of the skull and jaw, which occurs in relatively pure races, does not appear. As the jaw develops from before backward, were it not exercised by mastication or were any permanent teeth extracted or had the third molar failed to appear, the length required would necessarily be much less than that needed by a jaw full of teeth or well exercised. Under the law of economy of growth only the posterior parts of the jaw actually necessary develop and thus resulted the short lower jaw.

The jaws of people whose ancestors have lived in the United States show that there is not such a great difference in the width of the jaws. Thus in private patients in Burlington, Vt., Boston and Chicago, there is only about .9 in women and in men about .03.

By comparing these measurements with those of the ancient Britons made by Mummery and Coleman there is found a difference of about .36. The difference between ancient Romans is about the same. The difference between the ancient Britons and the English of to-day is about .24 and of ancient Romans and present Italians of Southern Italy, .31. The antero-posterior

diameter of the present size of the jaws is about as low as the lowest of any of the measurements.

On comparing measurements of New England stock with those of ancient Britons there is found a difference from .21 to .36, between ancient Romans and New England stock .32. Between the so-called Anglo-Saxons and New England stock, .27, and between New England stock and present English, .09.

A much greater difference would be evident in the width of the jaws of New England stock and the jaws of early races had the measurement been taken from the first or second bicuspid region since the contraction is anterior to the first permanent molar.

The wisdom tooth grows smaller with rise in evolution. In the gorilla the third molar is in every respect a well developed tooth sometimes even larger than the first or second molar. Instead of an imperfect crown it has a crown on which the cusps are arranged according to the typical pattern. The wisdom tooth (in primitive races) has ample space to range with other teeth and is a characteristic molar. In higher races the lower wisdom tooth exceptionally has the four cusps distinctly developed. According to Mummery the third molar among African tribes is always present in the lower jaw. According to Allen the third and fourth molars in Australians often show a tendency to the bicuspid type. Still more marked differences are found between primitive and civilized man than between the primitive man and the mammals.

The alveolar process is a transitory structure. Bone is relatively permanent. The alveolar process depends entirely upon the wedging of teeth against each other for size and shape. In primitive races although the wisdom tooth does not present the variation found in more advanced races still it is far inferior to the teeth of the anthropoid and lower apes. In them is found the primitive indication of degeneracy and subsequent disappearance of this tooth. The tooth in all is, however, as serviceable as other molars. Among monkeys the third molar may be of equal size to the first and second or it may be larger or smaller.

These teeth according to Charles Darwin are rather larger

than the other two molars in the orang and chimpanzee. In macaques (Tomes) the third molar is larger than the first two and is quinquicuspid below and quadricuspid above. In man as a rule, the molars decrease in size from before backward. The first molar is largest while in the anthropoid apes the contrary is the case. There are, however, notable exceptions; in the Australian as in the chimpanzee the second and third molars are not smaller than the first. In the anthropoid apes the wisdom tooth is generally as large as other molars, is not very variable and comes into place almost simultaneously with the canine. The diameter of the jaw is frequently much smaller laterally and antero-posteriorly than the diameter of the teeth and alveolar process. In man's evolution the loss in number of the teeth is not in harmony with the arrest of development of the jaw.

In the evolution of man from the extreme dolichocephalic and brachycephalic to the mesophalic skull, there is a natural recession of the jaws in the antero-posterior and lateral direction.

Disuse of the jaw as a weapon (evident in the large canine of the male anthropoid apes) exercised an influence in reducing the size of the jaw and the teeth. The Neanderthaloid jaw is allied in type to that of the anthropoid apes. The scanty weapons of the Neanderthal man indicates that biting (as among rowdies to-day) played no small part in battle and particularly in duels for female favor. With development of weapons this employment of the jaw rapidly fell into disuse.

One of the chief factors conductive to arrest of development of the jaws which acts in a three-fold ratio is want of maxillary exercise. This under the law of economy of growth produces the following results: By lack of exercise, blood which nourishes the bones is not carried to the part. Blood does not carry sufficient material to the teeth, hence, the enamel formed is defective as a result early decay occurs. By lack of lateral motion mechanical development of the alveolar process is wanting. The jaw is steadily growing smaller. Early races lived upon coarse food; roots, herbs, corn and uncooked meats. Such food required considerable mastication in order to secure

chemical changes necessary before assimilation. As a result of use the muscles of the jaw were dense and hard. When contraction took place they stood out upon the sides of the head like large cords. The bones were well developed and of dense, hard structure. The processes for the attachment of muscles were prominent and large. The teeth were large and deep set in the alveolar process.

The upper jaw is a fixed bone. The blood supply is small owing to a lack of stimulus from movement, hence, arrest of development is marked. On the other hand from the lower jaw being movable more blood flows to the part which thus becomes increasingly developed. In neurotics and degenerates the slightest assistance to circulation will cause the lower jaw to become excessively developed. Some dentists misconstrue this condition and call the procedure for its correction "jumping the bite."

The teeth upon the upper jaw are more subject to decay than those upon the lower despite the fact that environment of the teeth upon the lower jaw, especially the bicuspids and molars, should render them most subject to decay. Teeth are not equally subject to caries. The upper are more frequently attacked than the lower according to Magitot in the proportion of 3.2 or according to Hitchcock in the ratio of 1.9;1 or very nearly two to one.

Taste has been so far cultivated that it now requires the skill of cooks to produce dishes free from peculiarities presented in the early days of cooking. Thus all coarseness has been removed from food. Cereals are reduced to the finest flour while the hulls which contain the phosphates essential to bone building and necessary for mechanical grinding by the jaw are entirely excluded—the growing inclination of the race is to use food which requires little if any mastication. A society fad (etiquette in mastication), whereby the lips are closed and the motion of the jaws in chewing is barely perceptible does not conduce to strength and vitality, but to atrophy or arrest of development. The evolution of the face from prognathism to orthognathism is thus accelerated.

When the teeth push their way into place they crowd one

another laterally. By so doing the dental arch enlarges and the alveolar process develops and grows about the teeth. The lateral movement of the lower jaw in the act of chewing assists greatly in producing the enlargement. The constant movement of the lower against the upper teeth causes them (in many cases or irregularities) to arrange themselves in their proper places. Thus a want of mastication may cause arrest of development of the jaw and consequent irregularity of the teeth.

The jaws and teeth may exist in each parent in perfect symmetry. In one parent the jaws and teeth may be large; in the other parent small, but each is normal. If now the small jaw of one parent and the large teeth of the other appear in

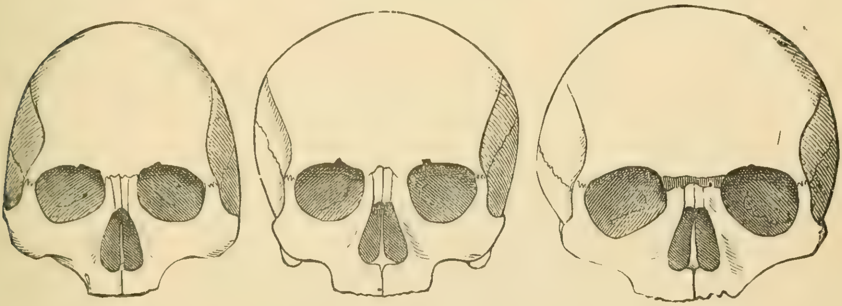

Fig. 4. Fig. 5. Fig. 6.

the offspring deformity is sure to follow. By examining the figures of the dolichocephalic (Fig. 4), Sarmatic brachycephalic (Fig. 5), and the Turanic extreme brachycephalic (Fig. 6) types it will be seen at a glance how entirely different must be the single measurement not only of the skull generally, but the face and particularly the superior maxillary bones.

Suppose, for example, that a person with one form of cranium (Fig. 4) be married to one with another (Fig. 6), perfectly harmonious blending of cranial differences would scarcely be possible, even were both parents in perfect health and were the offspring to remain in perfect health throughout the periods of stress.

CHAPTER VII.

DEVELOPMENT OF THE ALVEOLAR PROCESS.

The alveolar processes are situated upon the superior border of the inferior maxilla and upon the inferior border of the superior maxilla. These bones are considered a part of the maxillary bones, and are so described by anatomists. They should, however, be considered and described as practically separate and distinct bones. Their structure, embryology and functions differ completely from the structure and functions of the maxillary bones. The superior and inferior maxillæ are (unlike the alveolar processes) composed of hard, compact bone-structure. The large, powerful muscles attached to them indicate that powerful work is to be accomplished. When fully developed they retain their full size through life. The alveolar processes are composed of soft and spongy bone of a relatively cancellous structure. As early as the eleventh week of intra-uterine life, calcification of the deciduous teeth commences, and by the twentieth week calcific material is quite abundantly deposited. Ossification is also rapidly progressing about the dental follicles. At birth the sacs are nearly or quite enclosed in their soft, bony crypts, and the crowns of the teeth upon their outer surface are composed of enamel, which is dense and hard.

The embryologic phases of the dental shelf elsewhere cited, further illustrate this development.

The alveolar process, being soft and spongy, molds itself about the sacs containing the crowns of the teeth and about their roots after their eruption, regardless of their position in the jaw. While the alveolar processes have grown rapidly, they have, up to this time, developed only sufficiently to cover and protect the follicles while calcification proceeds. When the crowns have become calcified and the roots have begun to take in their calcific material, absorption of the borders of the processes takes place in the order of the eruption of the teeth. When the teeth have erupted, the alveolar process develops downward and upward with the teeth until it attains

the depth of the roots of the teeth, which extend in most instances into the superior maxillary bone, in the anterior part of the mouth at least and the upper and lower teeth rest at a point in harmony with the rami. The depth to which they penetrate the bone differs in different mouths. This depends upon the length of the roots and the alveolar process. This in turn depends upon the length of the rami. The incisive fossa, the canine eminence and the canine fossa give evidence of this externally. These sockets are lined with extensions of the process, thus making its upper border irregular. The fact that some of the teeth are fixed in the bone as well as in the alveolar process makes the correction of some forms of irregularity more difficult, for not only does the process have to be reshaped, but the bone as well. This is quite noticeable in correcting irregularities

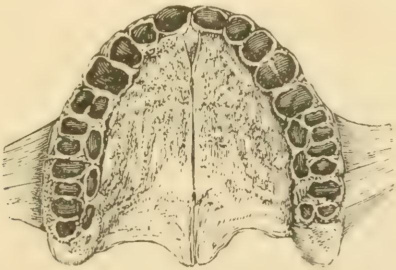

Fig. 7.

of the teeth in the lower maxilla. The crypts of the permanent teeth are located at the apices of the roots of the temporary teeth. The permanent teeth have large crowns which touch each other, forming a line to the posterior part of the jaw. These teeth, as they erupt, entirely absorb the alveolar process which surrounded the temporary teeth, and, as the new set come into place, a new process is built up about them for their support. The permanent teeth require a deeper alveolar process to support their roots, which are much longer than those of the temporary teeth. Hence the difference in the depth of the vaults of the first and second sets of teeth.

The alveolar process of each superior maxilla includes the tuberosity, and extends as far forward as the median line of the bone, where it articulates with the process upon the opposite

side. It is narrow in front, and gradually enlarges until it reaches the tuberosity, where it becomes rounded.

If the two articulated superior maxillary bones be examined it will be seen that the anterior part is curved, while the posterior part gradually diverges from the central line of ossification of the maxillary bones. The shape varies in different individuals. Some arches are small and others large; the arch is parabolic in some cases and circular in others.

The process is composed of two plates of bones, an outer and an inner, which are united at intervals by septa of cancellous tissue. These form the alveoli for the reception of the roots of the teeth. In some cases the buccal surfaces of the roots of healthy teeth extend nearly or quite through the outer bony plate and are covered only by the peridental and mucous membranes.

This plate is continuous with the facial and zygomatic surfaces of the maxillary bone. The inner plate is thicker and stronger than the outer, and is fortified by the palate bones. The external plate is irregular upon the outer surface, prominent over the roots of the teeth, and depressed between the roots or interspaces.

The prominence over the canine teeth, called the canine eminence, is very marked, and decidedly modifies the expression of the face. The sockets of the central incisors are conical and round; those of the lateral incisors conical and slightly flattened upon their mesial and distal surfaces, and not so large as the central sockets.

The pit for the cuspid is conical and much larger than any of the other sockets. The sockets for the bicuspids are flattened upon their anterior and posterior surfaces, and near the apex they are frequently bifurcated. The sockets of the molars are large at the openings, but at about the middle of their length they are divided into three smaller sockets for the reception of the roots. In the case of the third molar the number of sockets ranges from one large cavity to three or four of smaller size.

The alveolar process of the inferior maxilla extends from the ramus of one side to the same point on the other. The

outline is similar to that of the superior process, the anterior portion being much thinner.

The description given of the structure of the superior process applies also to the inferior. The outer plate of bone opposite to the molars and bicuspids is thicker than the inner plate, while the inner plate opposite the canines and incisors is thicker than the outer.

The alveoli are arranged along the border of the bone for the reception of the roots of the teeth. They correspond in form to the roots which they accommodate. The alveoli for the central incisors are smaller than those for the lateral. They are conical in shape, and flattened upon their mesial and distal surfaces. Those for the lateral incisors are larger, and compressed on their mesial and distal surfaces. The sockets for the canines, cuspids, or stomach teeth, are larger, deeper and less compressed than those for the incisors.

The sockets of the bicuspids are considerably flattened upon their lateral surfaces, and are sometimes divided into two cavities. The sockets for the anterior roots of the molars are broad and flattened laterally, while those for the posterior roots are round. The third molar, being naturally of variable form, has sometimes one pit, and again three or four. Each alveolar pit or socket is divided from its neighbor by a small wall or septum, which is made up of cancellated bone, extending about one-eighth of an inch above the inner and outer plate.

The dental septa assist in keeping the teeth firmly in their places. The septa are very thin at the margin, and gradually increase in width to the middle of the jaw, where they become thicker, and are finally lost in the substance of the jaw. Some septa are thicker than others, and where two teeth are widely separated, the width of the septa naturally corresponds to the space between the teeth.

In the evolution of the jaws with arrest of development, there is, in most cases, a high vault. This new condition tends to lengthen the alveolar process. It becomes much thinner. What is true of the change in the size of the jaws and the alveolar process is also true in respect to the shape of the crowns of the teeth. While they are not growing smaller in proportion to

the size of the jaws, they are changing shapes. Once they were relatively bell shaped, giving considerable space between the roots for a thick alveolar process, thus rendering support to the peridental and mucous membranes, now the shape has changed. The proximal surfaces are almost straight, lessening the width and thus allowing only for a thin septum, with barely sufficient surface to support the tissues.

The sockets are lined with a thin plate of compact bony substance, extending from the outer and inner plate of the alveolar process to the apex, where there are small openings for the entrance of nerve and blood-vessels for the nourishment of the teeth.

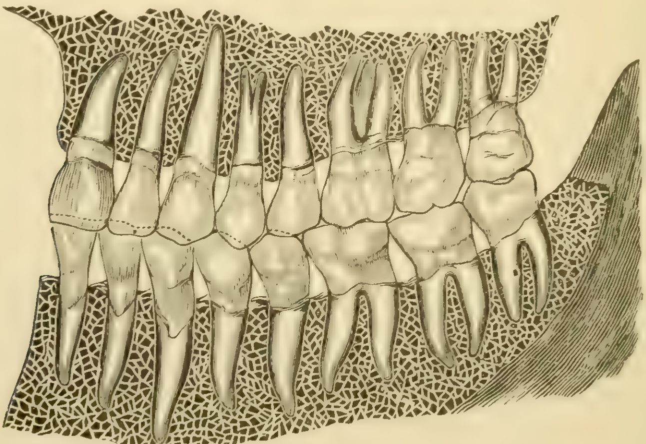

Fig. 8.

This bony plate has upon its inner surface the elastic peridental membrane, which acts as a cushion for the teeth, while upon the inner surface it is surrounded by spongy bone.

The teeth are held firm in their alveolar sockets by a union called gomphosis, which resembles the attachment of a nail in a board. Teeth with one conical root, and those with two or more perpendicular roots, are retained in position by an exact adaptation of the tissues. Teeth having more than one root, and those bent or irregular, receive support from all sides by reason of their irregularity. The teeth are also held in position by the peridental membranes. In Fig. 8 is seen the position of

the teeth in the jaws. The peridental membrane which lines the alveolus and covers the roots of the teeth is a fibrous tissue. that admits of slight motion of the teeth, and acts as a cushion to protect the jaws from severe blows and concussions while tearing and grinding food.

After removal of the permanent teeth the alveolar process is entirely absorbed. In Fig. 9 is shown how absorption takes place. The teeth have all been removed from the superior maxilla, as has also the alveolar process. The molars on the lower jaw have ben extracted, and absorption of the alveolar process has resulted, showing a marked contrast in conection with the anterior alveolar process, which remains intact and

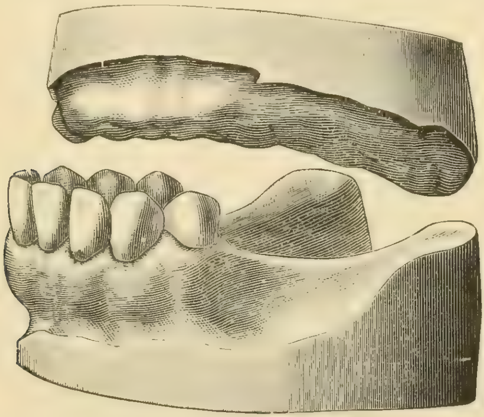

Fig. 9.

holds the teeth firmly in place. It is evident, from the changes which occur from the first development of the teeth to their final extraction, that the alveolar process is solely for the purpose of protecting the teeth in their crypts during development and after eruption. When the temporary teeth are in place the alveolar process remains unchanged (except a gradual enlargement in harmony with the growth of the maxillary bones) until about the sixth year, when the second set of teeth appears. The crowns of the permanent teeth require more space than those of the temporary set; and the alveolar process must necessarily enlarge to accommodate them. This enlargement of the alveolar process is caused by the formation of the crowns

of the permanent teeth before eruption, and to a limited extent by the growth of the maxillary bones, which may cease developing at any period of life, or continue to develop as late as the thirty-sixth year. The diameter of the crowns of the permanent teeth forming a larger circle than that of the maxillary bones, the alveolar process must necessarily increase its diameter. It is often forced outside of the superior maxilla by the crowns of the permanent teeth crowding and wedging themselves into positions anterior to the first permanent molar teeth. This enlargement of the alveolar process usually takes place anterior to the first permanent molars. The process corresponds in size to the jaws. In Fig. 10 shows a superior maxilla, comparatively

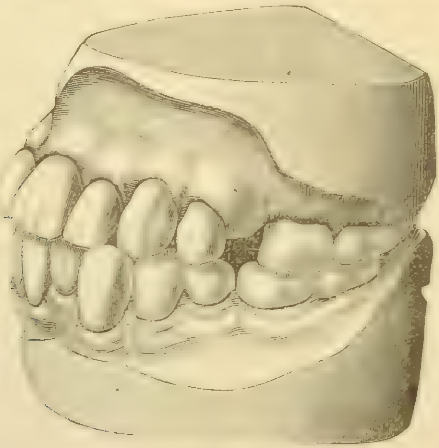

Fig. 10.

small in proportion to the inferior. This is the result of arrested development, the arrest including the bones of the face. To allow for the defficiency in bone-structure, and to allow the upper teeth to extend over the lower, the upper teeth have forced the alveolar process forward. The space shows where a tooth was extracted after all the teeth were in position. The teeth of to-day have not varied in size in proportion to the jaws. To compensate for this difference, the alveolar process has to expand, or enlarge, to allow the teeth to come in evenly. If the teeth antagonize uniformly the arch will enlarge around evenly. If the molars are fixed the alveolar process will expand

anteriorly. If the teeth should not antagonize evenly, a break will take place at that point, producing a V or saddle arch.

In Fig. 9 all the upper teeth have been removed and absorption has entirely obliterated the alveolar process. The relations of the superior maxillary bones to the alveolar process and teeth on the lower jaw are well illustrated. When the alveolar process and teeth were intact they presented an appearance seen in Fig. 10.

The position and shape of the processes and their relation to each other are governed entirely by the location and size of the teeth and roots, and not by the shape of the jaw-bone proper. The dental follicles containing the crowns may be located upon the outer border of the jaw-bone on one side, in

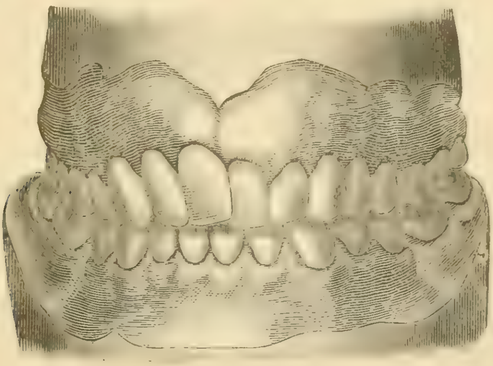

Fig. 11.

which case the alveolar process will be situated upon the outer border, and assume an irregular arch. If the crowns of the teeth are located upon the inner border, or if one jaw be smaller than the other, the teeth will articulate and the process will form a smaller circle than the jaw-bone proper. Such a case is illustrated in Fig. 11. The superior maxilla is much larger than the inferior, and, as a result, the articulation of the teeth and the muscles of the cheeks and lips have carried the teeth and alveolar process on the upper jaw inward. The teeth on the lower jaw are regular and appear to have sufficient room, while those upon the upper jaw are crowded and overlap each other. The teeth on the left side of the upper jaw are more

regular than those on the right side. Upon examining the mouth, or model, the arch on the left side will be found full and regular, while the arch upon the right side has a perfect semi-V-shape.

The alveolar process on the right side extends considerably over the border of the maxillary bone, and the teeth (especially the cuspid) have taken quite an incline in order to articulate with the teeth upon the lower jaw, thus crowding the alveolar process to the inner border of the maxillary bones.

The process is solely for retaining the teeth, and if for any reason the dental follicles should not be present and the tooth should not erupt, or if it should have been extracted early, the process would not be developed at that point. In my collection of models may be seen cases of arrested development of the

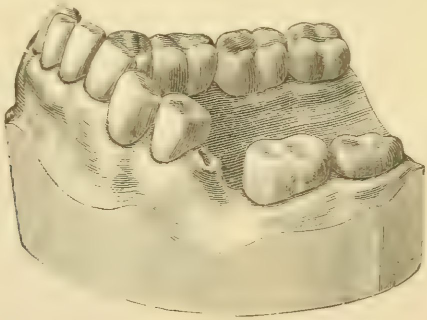

Fig. 12.

alveolar process, caused by the lack of bicuspid and lateral incisor germs, and by the extraction of the deciduous and permanent teeth.

If one or more teeth should not antagonize, the alveolar process would extend beyond the natural border, carrying the teeth with it. A marked illustration of this is seen where the molars are decayed to the gum and the roots remain. The vascularity of the process is such that its development results. Excessive development of the alveolar process is frequently observed by every practitioner in connection with the anterior inferior teeth. When the articulation is normal, occlusion of these teeth never takes place. It is frequently found (espe-

cially in patients from six to twelve years of age) that these teeth extend to and occlude with the mucous membrane of the hard palate, making one of the most difficult forms of irregularities to correct. Such a case is illustrated in Fig. 12. This model is taken from the jaw of a person thirty-seven years of age, but this excessive development probably took place between the ages of six and twelve, because at that period the vascularity of the tissues is more vigorous and the development of the process more formative than at any period subsequent to the development of the first permanent teeth.

In a case in which the incisors and cuspids, together with their alveolar process, were situated upon the external surface, while the bicuspids, molars and their alveolar process are located upon the inner border of the jaw. In another case the alveolar process failed to cover the roots of the bicuspids and molars upon the outer surface, the teeth having forced themselves into a larger circle through the alveolar process by the contact of the crowns. The roots in this case can be easily outlined by the finger through the mucous membrane; the outer plate of the alveolar process barely, if at all, covering them. Tomes illustrates a case of faulty development of the outer plate of the alveolar process exposing the crowns of all the temporary teeth. The case was a child who had suffered from hydrocephalus. I have a number of models showing the anterior alveolar process projecting beyond the normal position by the forward movement of the molars. This may be due to a natural movement of the molars forward, or the process may be forced forward by the improper occlusion of the jaws. The teeth are moved from one position to another simply by the force consequent upon absorption and deposition of bone. This is noticeable in the spaces between the centrals, when the alveolar process develops to a larger circle than is necessary to accommodate the teeth. The alveolar processes are influenced in one direction or the other by the pressure of articulation. This abnormal condition is the result of inharmonious development of the jaws. The teeth may come together in such a manner as to throw the alveolar processes either to the right or left, thus producing a full round arch upon one side of the

jaws and a perfectly flat or straight arch upon the other. (Fig. 11). The greatest deformity is that in which the teeth of the upper jaw and alveolar process are forced forward, causing a protrusion of the anterior superior part of the mouth. Occasionally both upper and lower alveolar processes are carried forward in the same manner. The alveolar process upon the lower jaw is more liable to be found upon the inner border of the jaw than is the upper alveolar process, as the inferior maxilla is larger and more dense than the superior, and when the teeth are once in position upon the lower jaw they are not liable to subsequent change. As the jaws become smaller and more delicate, the anterior alveolar process becomes thinner and less liable to resist the forward movement of the molar and cuspid teeth, thus producing anterior protrusion and V-shaped irregularities. Owing to this fact the teeth of the superior maxilla do not form so great a circle, causing the teeth upon the sides of the jaws to conflict and the lower teeth and alveolar processes to be carried in, while the anterior teeth of the lower jaw are held inside of the superior anterior teeth, thus carrying the alveolar process inward.

The teeth are continually changing their positions in the mouth. This is as often beneficial as it is detrimental. That the teeth may perform their full function, they should not only remain firmly fixed in the alveolar process, but should also antagonize. The teeth may be compared to the bricks in an arch; remove a brick and the arch falls to pieces. It is frequently found that the teeth do not articulate properly, and by cutting away the approximal surfaces a better articulation may be secured. When this operation is performed the teeth move in their sockets by absorption and deposition of bone, demonstrating the fact that the process changes in shape and substance.

The tendency of the alveolar process to develop between the sixth and twelfth year (two periods of stress) is something marvelous. This seems to be its period of greatest activity.

Physiologic development, however, is governed entirely by the eruption of the teeth. The air passages may become filled by excessively developed bones or mucous membrane, by

adenoid vegetation or other causes; as a result mouth-breathing will take place.

The lower jaw drops, and the pressure is taken away from the teeth.

In idiocy, and imbecility, and other degenerate conditions, mouth-breathing is very common. In these cases a long, thin alveolar process occurs. The teeth continue to erupt, and the alveolar process elongates. Occasionally when the mouth is closed the six anterior teeth will elongate, and the lower incisor will penetrate the superior alveolar process. In such cases the superior incisors protrude and separate. This deformity will continue until the upper incisors cease to develop, owing to the pressure of the alveolar process upon the lower incisor teeth.

The first thing to do to correct this deformity is to place a plate in the mouth, to allow the lower incisors to rest upon the plate.

In this manner the pressure is taken from the bicuspids and molars. In two or three months' time the posterior teeth and alveolar process will elongate from .12 to .16 of an inch; thus showing the possibility of the development of the alveolar process in a short time by removing the pressure.

In some cases excessive development of the alveolar process goes on very rapidly, especially in epileptics.

This, however, takes place at the time of the development of the first teeth.

From what has already been said of the vascularity of the alveolar process, it is evident that hypertrophy of the tissue ensues from simple irritation of varying degree. The irritation consequent upon the eruption of the teeth, together with the excessive blood-supply are both primal cases of over-building of tissue, i. e., hyperplasia.

The ragged roots of the temporary teeth, produced by absorption, the gases from the putrescent pulps, and the pressure of the permanent crowns against the tissues, produce sufficient stimulation to excite physiologic action. Tissue-building generally is seen in connection with the teeth posterior to the cuspid, rather than with the teeth anterior to that tooth. It seems

accountable only from the fact that the incisors have sharp cutting-edges, the roots of the teeth are single and nearly always shed before the permanent teeth are in place, and they erupt at an age when there is less vitality. Per contra, the crowns of the teeth posterior to the cuspid are broad, the roots of the temporary teeth posterior to the cuspids are more numerous than those anterior to them, and, with the exception of the first permanent molars, they erupt at the age of greatest vitality. Epileptics most often possess these stigmata. Excessive development of the alveolar process is unusually common among them, as is also the case with the muscles of the body. The

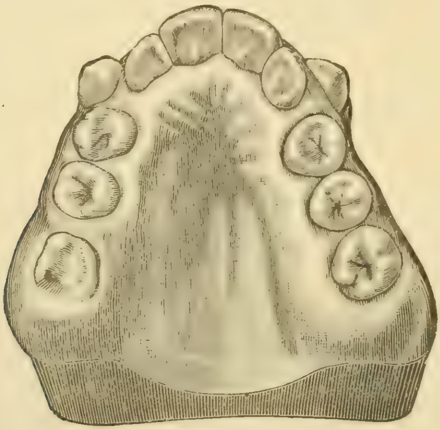

Fig. 13.

process becomes unnaturally thick, the bicuspids and molars are carried in one direction and another, effecting a variety of irregularities. I have frequently observed hypertrophy in connection with epilepsy. This is due to unstable tissue-building, often found among degenerates. A common form is shown in Fig. 13. Similar irregularities are also seen in Cole's "Deformities of the Mouth," Figs. 12, 13, and 27; and in Tomes' "Dental Surgery," Fig. 90. These deformities all take the contour of the saddle-shaped arch. This may be accounted for from the fact that the permanent molars, being the first teeth to erupt, become fixed before the deposit commences. The crowns of the bicuspids are also held in a small circle by the retention

of the temporary molars. When these teeth do not antagonize they are liable to be carried inward.

The cuspids, with their long roots, meet resistance either in connection with the teeth adjoining or with those upon the opposite jaw, and are thus held in position. It will be observed that, in all these cases, the enlargement seems to be associated with the inner plate of the alveolar process. In most of these cases the inner plate is the part of the alveolar process affected. The outer plate, although quite irregular from the arrangement of the teeth, is usually normal in thickness. This disparity in

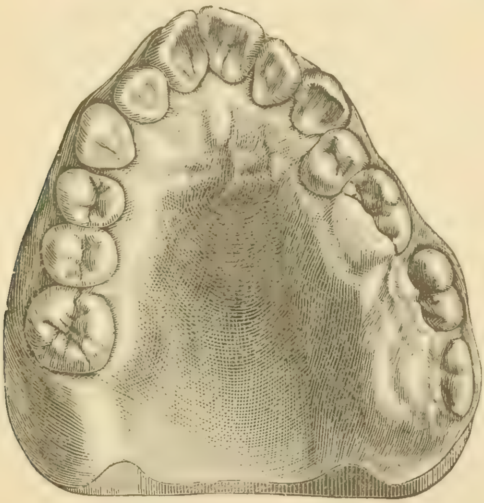

Fig. 14.

the two plates of the aveolar process may be accounted for from the fact that the inner plate of the alveolar process possesses a large blood-supply—the posterior or descending palatine arteries furnishing the ossific material. I have observed cases where the hypertrophy has extended to and included the outer plate. When the outer plate becomes involved the alveolar process assumes a very thick condition. Occasionally, hypertrophy will affect one side only or one distinct locality. In Fig. 14 is seen such a case. In this case the enlargement is upon the left side and extends from the first bicuspid posterior to, and including, the maxillary tuberosity. Instead of the force

being directed inward, as is generally the case, the process is forced outward and backward. This enlargement occurred previous to the development of the second and third molars. The alveolar process extends downward and occludes with the teeth upon the lower jaw, thus preventing the molars from erupting.

Under the microscope, two systems of Haversian canals are seen in the alveolar process.

These Haversian canals, according to Kolliker,[1] are of two kinds. One with the regular lamellæ system surrounding it, and the other, the so-called Volkmann's canals, containing the

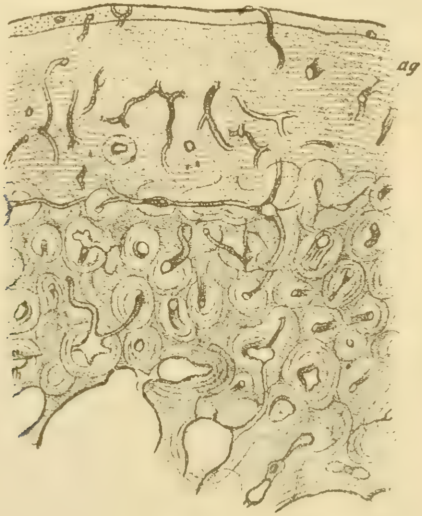

Fig. 15.
Section of Bone showing Blood Vessels of V. Ebner.

perforating vessels from Von Ebner, which have no surrounding lamellæ, but simply penetrate through the layers of bone. Volkmann's canals are present in all tubular bones in old and young. While especially present in the outer basal lamellæ, they occur also in the interstitial leaflets and in the inner chief lamellæ as well as in the periosteal layers of the skull bone. Here their number is very variable (Fig. 15). They run partly transversely or obliquely, and also partly longitudinally through the lamellæ. Many of these canals open in the outer or inner surfaces of

[1] Handbuch der Gewebelehre, page 272.

the substantia (compact substance), and also here and there in the Haversian canals, and form altogether usually a wide-meshed irregular net-work. In their structure they are sometimes smooth and sometimes furnished with dilatations and angles projecting in and out in profile. The widest has a diameter of 100 micrometers or more, and the narrowest not more than 10 or 20 micrometers, and there are still narrower ones which are altogether obliterated, appearing like rings or circular-

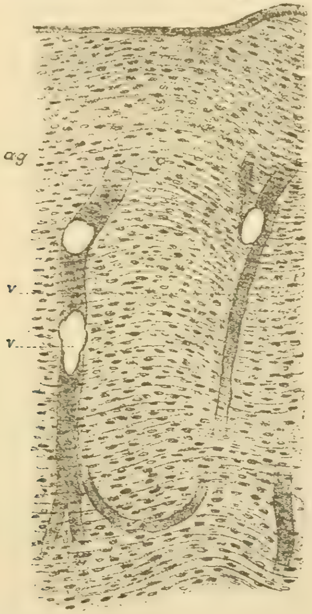

Fig. 16.
Section of Bone (higher magnification)
showing Blood Vessels of V. Ebner.

formed structures without any lumen, or like those far from rare obliterated true Haversian canals first described by Tomes and de Morgan. The contents of the Volkmann canals are the same as the Haversian canals.

Fig. 15 is a cross section of the medulla of a calcified human humerus slightly enlarged. The outer lamellæ contains a large number of Volkmann's canals running longitudinally and transversely and extending through the outer plate of bone into the periosteum. Fig. 16 the cross section of the section seen in

Fig. 15 shows these canals more highly magnified. The Haversian canals are large round spaces (Fig. 17), containing a single artery and vein. The fine hair-like spaces running from these large spaces are canaliculi. The dark spots encircling each Haversian canal are the lacunæ. The canaliculi run from one

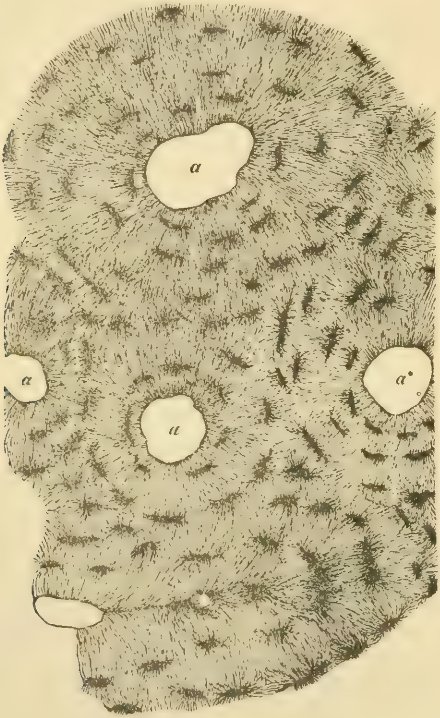

Fig. 17.

Transverse section of the Diaphysis of the Humerus magnified 350 times. *a*, Haversian canal. Dark spaces Lacunæ. Hair-like spaces Canaliculi.

lacunæ to another or into a Haversian canal, or they anastomose with each other. The lacunæ seem to be about uniformly distributed throughout the bone. The spaces between the lacunæ and canaliculi are filled with lime salts.

A longitudinal section of bone (Fig. 18) is similar in appearance to the cross section. Instead of the lacunæ being arranged in rows around the Haversian canals they are parallel. It will be noticed that the Haversian canals run in different directions

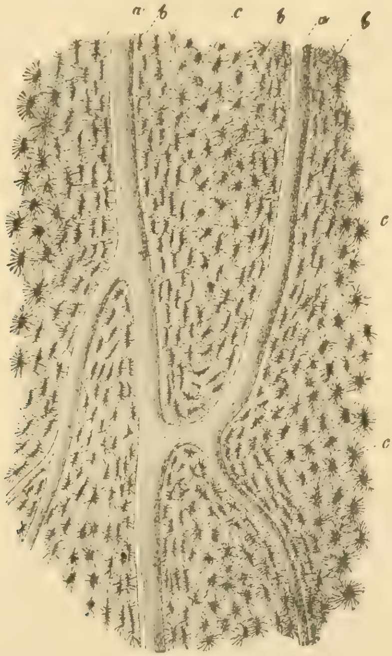

Fig. 18.

Longitudinal section of Bone magnified 100 times. *a*, Haversian canals. *b*, Lacunæ seen from the side. *c*, Canaliculi.

and communicate with each other at certain intervals. The foregoing covers essentially the minute anatomy of the alveolar process.

CHAPTER VIII.

DEVELOPMENT OF THE VAULT.

The roof of the mouth has received several names as the arch, another the dome, still a third the palate. The word arch, although used in its proper place, is often likely to be so confounded with the dental arch as to create confusion. Thus V or saddle-shaped arch is spoken of, but the reader is quite unable to decide whether the writer intended to refer to the dental arch or the roof of the mouth. In former papers I have used the term vault in distinction from the dental arch, and shall therefore continue its use in the present volume.

The vault of the mouth is made up of the hard palate, the soft palate, and the alveolar process. The hard palate consists of two horizontal plates of bone extending from the superior maxillary bone upon either side and uniting at the median line, and from the anterior alveolar process in front, it extends back on an average of two inches, when it unites with the soft palate. The hard palate is composed of six distinct parts; two incisive bones, two palate plates of the superior maxillæ, and two horizontal plates of the palate bones. The incisive bones, however, become so firmly united to the maxillary plate of bone so early in life that the suture becomes obliterated. The period of ossification of the median suture varies in different individuals, sometimes as early as the third and fourth years, and again as late as the fifteenth and sixteenth year.

Widening the arch by means of a jack screw, has opened the suture of the median line in fourteen children from twelve to sixteen years of age. This was accomplished by very little pressure, showing that union had not taken place. These were all neurotics.

As a whole, the hard palate may be described as a horizontal partition, or floor, separating the nasal cavity from the mouth. The anterior part of the palate bone unites with and becomes a part of the alveolar process. The upper surface of the hard

palate joins the floor of the nasal passages, which are divided in the center by the union of the vomer. This bone, which is quite thin at its middle portion and cartilaginous at the anterior part, begins to thicken as it reaches the floor of the nose, at which place it gradually produces a smooth appearance, dividing the nostril into two rounded arches.

Upon the palatal surface it is very uneven. Along the median line is frequently found a rough ridge of bone, resembling a section of rope, running its entire length, about the size of a slate pencil. Such a condition is frequently observed in Peruvian skulls. Out of 228 examined at the Peabody Museum, Harvard College, sixteen had this peculiar appearance. In more modern skulls are often present knots, or rough lumps of bone, at intervals along the suture. Again, a thick band of bone from .25 to .50 of an inch in width, extending part way or the entire length of the suture, occurs. This thickness, or prominence, commences at the alveolar border and becomes the widest at the second bicuspid and first permanent molar, where it gradually narrows to a mere point at a line drawn across the vault at the posterior surface of the second molar.

The hard palate varies in thickness in different localities and differs in thickness in different individuals. Around the edge where it unites with the maxillary bone and alveolar process it is quite thick, and also at the median line; while about midway between these two parts the bone is as thin as tissue paper. I have also observed it from .12 to .18 of an inch in thickness. At the median line, and just back of the incisors, is a fossa which transmits the anterior palatine vessels and naso-palatine nerves. At the posterior surface upon either side is a groove and an opening for the transmission of the posterior palatine vessels and nerves. Both the upper and lower surfaces of the hard palate are covered with mucous membrane, which extends backward and unites to form the soft palate. Between the two folds of mucous membrane are muscular fibres for the purpose of moving the soft palate in different directions. The shape and length of the soft palate depends upon the distance between the œsophagus and the edge of the hard palate. If the head of the individual be dolichocephalic, or long, the soft

palate will curve slowly backward, thus producing quite a long space between the incisor and uvula. On the other hand, if the person possesses a brachycephalic, or short head, the soft palate will curve abruptly, thus allowing only a short distance in the vault of the month. I have observed mouths where the head was so short from front to back that the soft palate descended almost straight down without the slightest curve. The vault, taken as a whole, presents different shapes in different individuals.

The mouth of a child at the fourth or fifth year, normally

Fig. 19.

presents a well-developed jaw. The curves are all graceful in outline, and the contour of the dental arch is well formed. This could hardly be otherwise, for the reason that the jaw is growing rapidly for the purpose of accommodating the permanent teeth, and the circle of the alveolar process is larger than that of the teeth. Spaces exist between the teeth, and therefore crowding cannot take place.

As a matter of course no two vaults are alike in height, width or contour, although each is normal in itself. As is obvious from the chapter upon the alveolar process, in the development of the jaws are two structures, the hard, dense bone of the maxilla and hard palate, and the soft, spongy bone—the alveolar

process. The maxillary bones develop and unite at the median line. The contour of the top of the vault is now established. It is held in position, on the sides, by the walls of the antrum, supported by the malar process and by the anterior alveolar process and maxillary bone. In this manner the vault is held in its natural position. The maxillary bones, like all the other bones of the head, develop in every direction in a general way, until the growth is established. Between the period of birth and two years (when all the temporary teeth are in place) and twelve or fourten years (when all the permanent teeth are in position) great changes take place in the shape of the jaw. This change is nicely illustrated in Figs. 19 and 20.

Fig. 20.

Fig. 19 illustrates the face of a girl, three years of age, the bones of the face and head all undeveloped. The bridge of the nose is sunken, the upper lip is short, as well as the jaw from the lower lip to the chin. How different the appearance of the same girl at thirteen (Fig. 20). While the width from cheek to cheek has not changed to any great extent, the length of the face from the chin to the top of the head is very marked. No part of the face has changed more than the lower—from the nose down. This change is due partly to the change in the angle of the lower jaw, and partly to the development downward of the superior alveolar process. In young life, the lower jaw

presents an obtuse angle; this gradually changes until at middle life it assumes a right angle. In order that the alveolar process and teeth may compensate for this change as the second set comes into position, the alveolar process lengthens with the eruption of the teeth. This is proven by the location of the mental foramen, which is situated at the superior border of the lower jaw early in life, and at middle life just midway between the upper and lower border of the bone. The same changes take place in the upper jaw. This is quite noticeable on the sides of the alveolar process at the roots of the first permanent molar soon after it has erupted. When the crowns of the bicuspids are ready to advance, and absorption of the roots of

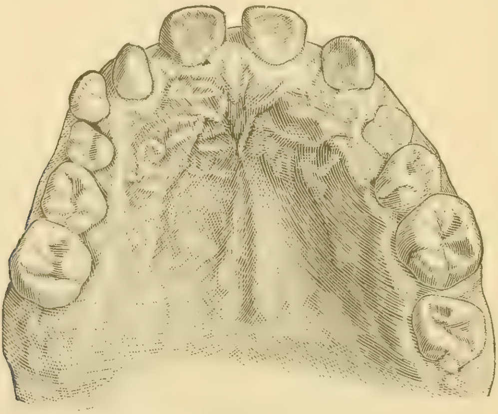

Fig. 21.

the temporary molars take place, there is some irritation in the alveolar process. The first permanent molar coming into position advances further than the line of articulation of the temporary molars, and the pressure of the jaws rests upon the first permanent molars. This fact, together with the irritation already mentioned, has a tendency to lengthen the alveolar process, so that when the bicuspids come into place there is a difference in the height of the vault. There are plenty of illustrations to show this development of the alveolar process, and every practitioner of dentistry has observed this.

One of the most common illustrations is that when the molar teeth upon the lower jaw have been extracted, the molars

upon the upper jaw (for want of antagonists) drop down by the lengthening of the alveolar process. The difference in the height of vault when the temporary teeth are in place and when the permanent teeth erupt is nicely illustrated in Fig. 21. This cut shows the permanent incisors and first molars in place. Note the lengthening of the alveolar process. In this manner the differences in length of the face occur. In those cases where the vault is very high, the alveolar process is always very long and thin. The depth of vault is also governed by the angle of the jaw. Thus, if from inherited constitutional disease, such

Fig. 22.

as consumption, syphilis, etc., arrest of development of the maxillæ should ensue, the angle would not change from an obtuse to a right angle. It will be noticed that when the mouth is opened the anterior part has to travel a greater distance than the posterior part, hence either the anterior inferior alveolar process will elongate so that the lower incisor will articulate with the upper (Fig. 12), or the anterior superior alveolar process will elongate to meet the lower incisor and bicuspid. Occasionally this will take place in both jaws. In either case the superior alveolar process becomes long and thin, and the vault is quite high. In cases of arrest of development

of the bones of the nose and adenoid growths, when it is impossible for the child to breathe through the nose, and mouth-breathing is a necessity, the jaws are separated, and the teeth not having a resting place, the alveolar process elongates and a high vault is almost always noticed; hence imbeciles and degenerates who keep the mouth open, as a rule, have high vaults. The high vaults and prominent teeth, and upper alveolar process due to this cause, are nicely illustrated in Fig. 22, etc. On the other hand, the jaws brought closely together are occasionally noticed. This is due (1) to a short ramus; (2) to right angles of the rami to the body of the jaw; (3) to arrest of development of the alveolar process, and, (4) to teeth with short

Fig. 23.

crowns, or teeth not fully erupted. In such cases the vault is low, the alveolar process thick, and usually the lower jaw is quite broad. The lips pout, the face is short and broad. Frequently the upper jaw is arrested in its development; the muscles of mastication are very set and rigid. Such a case is illustrated in Fig. 23.

The height of the vault, then, is not due to the roof's being pushed or pulled up by a pressure exerted through the vomer by the development of the sphenoid bone, nor does the shape of the base of the skull in any way affect it, as I have already explained. The height is due entirely to a growth downward of the alveolar process and teeth. The extent of the develop-

ment of the alveolar process depends upon equibalance of nutrition, harmonizing the jaws, alveolar process, and length of teeth. That the distance in height is changed from a child to a person of middle life is demonstrated by the following figures: Thus in 317 children, under five years of age, before the development of the first permanent molar and alveolar process, the lowest vault measured .17; the highest .62, with an average of .42. In the height of vaults in children at different ages, there is a gradual advance in the height of the vaults until in 4,614 adult vaults, we have: lowest, .21, highest, .84, with an average of .58. It will, therefore, be observed that the height of vault develops about .25 to .33 in depth after the permanent teeth commence to erupt. Fig. 24 illustrates an instrument invented by me for the purpose of measuring these cases; it also shows the position of the instrument upon the model when the measurement is made.

The height of the vault in most cases is far below the average of the present day. In 4,614 measurements of normal individuals, made by the author, it was found that the average height of the arch was .58 of an inch; the measurement was made from the alveolar border between the second bicuspid and the first permanent molar to the height of the arch. The average of two hundred and fifty-one skulls of ancient and modern Romans, Indians, etc., was .56; allowing for the thickness of the mucous membrane, the average height of the vault of the present people would be a little below that of the Indians, negroes, ancient Britons and Romans. In 908 measurements of the vaults of ancient and modern Romans, Peruvians, Sandwich Islanders, Mound Builders, American Indians, negroes, etc., the minimum height of vault was .25, while the maxmium height was .88; average, .53. On comparing these figures with those of modern individuals, the lowest vault is found to be a little higher —.04—than in modern, and the highest a little higher—.04. The average, however, is a little lower than in the modern vaults by .05, thus showing that the ancient and race pure individuals possess more uniform and lower vaults than modern. The height of the vault hence depends upon the length of the face from the chin to the top of the head. So far as the height of

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the vault is concerned, no race, type, sect, or intellect can lay claim to high, medium, or low vaults.

What are the elements of a normal vault is a difficult ques-

Fig. 24.

tion to answer. I possess six skulls, obtained under difficulties from a medical college, and not selected for any particular purpose.

The lateral measurement was made between the roots of the second bicuspids, and the antero-posterior measurement between the central incisors at a point intersecting a vertical line dropped from the posterior nasal spine to the posterior border of the palate bone. The height of vault was taken from a horizontal line extending from the alveolar process on one side to the alveolar process on the opposite side, just back of the second bicuspid teeth.

The following measurements were taken (see Table VI):

Nos. 1 and 5 possess very much the same contour of the dental arch, while Nos. 4 and 6 are very broad, with square dental arches.

The heights of the vaults are all different, although two are flat, while the others are more or less rounding. Yet all are normal, while no two are alike.

I have examined hundreds of plaster casts, where the teeth were all in a fairly normal position, with similar results.

Of 372 skulls of Peruvians, California Indians, Mound Builders, and American Indians, the lateral measurement varied from 1.12 to 1.75, and the antero-posterior from 1.75 to 2.75, while the height of the vault varied from .24 to .75.

Oakley Cole made careful measurement of a number of skulls, chiefly in the museum of the College of Surgeons, London, England. The skulls examined fall into two series, viz.: those of European origin, and those of mixed races, with the following results (see Tables VII and VIII):

In each of the cases that I have examined, the dental arch was in a normal condition. I have also examined the skulls mentioned by Oakley Cole, and I have been unable to find but few contracted arches in any of them. If, therefore, in the examination of thousands of skulls having normal dental arches, no two vaults are found to correspond, it is evident that a normal vault is one where the dental arch is regular, and the different outlines possess graceful curves, regardless of height, width and length.

The width of the vault depends upon two factors: First, the development of the jaw bone proper, and, second, upon the development of the alveolar process.

Narrow jaws are rarely observed among pure races. In the examination of the thousands of skulls of early races in the museums of Europe and this country, very few, if any, contracted vaults are found. If the brain is in a healthy condition and the child properly nourished, the jaw-bone will develop in size sufficiently to accommodate all the teeth when they erupt. The teeth will crowd against one another as they come into place, and a normal width of arch will be produced. If the brain be defective, as the result of some of the constitutional diseases, and the jaw becomes arrested in its development just before sufficient room had been secured for the teeth, they will crowd against one another, the arch will become broken, and the V or saddle arch, or some of their modifications, will be formed; hence a narrow, contracted vault. The amount of contraction depends upon the size of the jaw-bone proper; if the bone has become arrested early, the jaw being small, the contraction is usually very great. The alveolar process depends entirely upon the location of the teeth for its shape and size. Occasionally the teeth (which are small) are inherited from one parent, and the jaw-bone proper (which is large) from the other parent. In such cases the alveolar process sometimes contracts until teeth antagonize, when a small arch will be produced. V and saddle shape arches and their modifications are observed as often among low vaults as among high ones in normal jaws. The contraction is due to arrest of development of the jaw at the time of the eruption of the permanent teeth; the vault may be high or low. What appears to be a high vault is not in the height of the vault, but in the width. Having now explained the true cause of what appears to be a high vault, what Clouston calls neurotic and deformed, are found to be one and the same. Both are neurotic, but one is more contracted than the other; both are due to arrest of development of the maxillary bones. There are high and low vaults among the ignorant as well as the intellectual, among the colored as well as the white, among the brachycephalic and mesocephalic

as much as among the dolichocephalic, among the deformed, or contracted, as much as among the normal. The width of the vault depends upon the development of the maxillary bones; if it develops to a size sufficient to accommodate all the permanent teeth, it will be a normal vault, regardless of height. On the other hand, if arrest of development of the jaw takes place, these deformities result in a V or saddle arch or some of their modifications. How, then, shall vaults be classified? In the measurement of the height of vaults of 8,654 ancient and modern skulls in this country and Europe, the highest was .88, the lowest, .25, with an average of .53. In the measurement of 6,387 mouths of persons over twenty years of age, the highest is .84, the lowest, .21, with an average of .58. In the measurement of 616 insane at the Eastern Illinois Insane Asylum, the highest is 1, lowest .12, with an average of .54.

Taking these figures into consideration, it is safe to average the height at .55. Allowing .15 of an inch in each direction, vaults which measure below .40 may be called low vaults; those between .40 and .70, medium vaults; those above .70, high vaults. We could still classify those below .25 very low vaults, and those above .85 very high vaults. The width of vault measured between second bicuspids and first permanent molars

In 8,654 ancient and modern skulls:

Maximum	1.63
Minimum	1.13
Average	1.36

In 6,387 mouths of living persons over twenty years of age:

Maximum	1.50
Minimum	.93
Average	1.19

In 616 insane people:

Maximum	1.87
Minimum	.75
Average	1.16

The vast difference in the ancient and modern skulls of this country and Europe, with those of living individuals, shows conclusively that the jaws are diminishing in size. A standard

is necessary to compare the width of the vaults as they occur to-day, excluding measurments of ancient and modern skulls and deformed jaws. Taking the 1.19 as the average width of vault, any jaw below 1 may be regarded as a narrow vault; one bewteen 1 and 1.40 medium width, and one which measures above 1.40 a wide vault.[1]

[1] While I believe that the views of Sergi (The Mediterranean Race) are justified, still they have not as yet been widely accepted by ethnologists and hence must be considered sub judice. His position in regard to the division of skulls into Ellipsoides, Ovoides, Pentagonoides, Beloides and Trapezoides is in my judgment justifiable and likely to prove of great advantage in craniology, which has hitherto been rather hampered by the paucity of its classifications.

CHAPTER IX.

DEVELOPMENT OF THE PERIDENTAL MEMBRANE.

The peridental membrane, like the periosteum is composed of fibrous tissue covering the roots of the teeth and lining the inner wall of the alveolus. They are both derived from the mesoblastic layer. For this reason there can be very little difference in the character of the structure of each, except so far as the function is concerned. The periosteum is made up of four different kinds of fibers. An outer layer of coarse, white fibrous tissue, an inner layer of fine, white fibrous tissue, elastic fibers and penetrating fibers (fibers of Sharpey).

The fibers of the periosteum are coarser than those of the peridental membrane. The coarser fibers run parallel with the alveolar process over the border and extend as far as the union of the epithelial layer and the periosteum.

The finer fibers, as Black has shown,[1] run in all directions and enter the alveolar process at every point. If a section of the alveolar process treated with acids or a section affected by halisteresis or osteomalacia be placed under the microscope, the fibers are seen to retain the original shape of the bone.

The fibers of the periosteum, therefore, are continued throughout the process from the periosteum on the one side to the peridental membrane on the other. This is also illustrated in the mouths of persons, where (after wearing artificial dentures for a short time) heat produces absorption of the lime salts, leaving the fibrous tissues intact.

The periosteum is abundantly supplied with blood-vessels which anastomose with each other and enter the alveolar process at the Haversian canals. The plexus of blood-vessels is much larger proportionately in connection with the alveolar process than with other bones of the body, owing to its transitory nature.

The peridental membrane commences at the margin of the

[1] Black: Dental Ligament.

epithelium at the neck of the tooth and is attached directly to the cementum. This membrane has various functions; First, it fills the space between these two structures, forming a cushion for the teeth to rest upon; second, like the alveolar process, it is present only when the teeth are present and, therefore, develops with the alveolar process when the first teeth erupt, it is entirely lost when the temporary teeth are shed, is restored with the eruption of the second set and when the permanent teeth are extracted it disappears with the alveolar process; third, it furnishes the nourishment for the teeth while they are in position in the jaw and holds them in their sockets.

The fibrous tissue in its earliest stages comprises nearly all or quite all of that portion of the jaw which eventually becomes the alveolar process (Fig. 261). Calcification begins at the center of the jaws and gradually closes in upon the fibrous membrane until it becomes the thickness of a sheet of paper. In young persons the membrane is much thicker than in old age, since, as age advances, the osteoblasts on the one hand and the cementoblasts on the other send out new material and each wall closes in upon the membrane, which becomes very thin in old age and almost lost.

The fibers which comprise this membrane extend in all directions; some crosswise penetrating the cementum, on the one hand and the alveolar process on the other. In a general way, since the fibers extend though the alveolar wall, they are more closely adherent to the bone than to the cementum and usually cling to the latter when the tooth is removed. It will be observed that these fibers do not enter into the alveolar process uniformly as claimed by Gray[2] and Pierce,[3] like tacks or nails driven regularly into a board (the fiber of Sharpey), but vary as to the quantity in different localities. In some localities they penetrate in large quantities and almost surround a piece of alveolar process, while a few fibers penetrate but a short distance. In some places, they can be traced almost through the alveolar process. These fibers are much finer in man than in the lower animals. In connection with the fibers which pass

[2] Anatomy.

[3] American Sy tem of Dentistry, page 668.

into the alveolar process are numerous blood-vessels. Others run diagonally, and still others lengthwise, all making up a tissue which holds the tooth in position in the jaw. The fibers enter the peridental membrane at all points of the process, from its margin to the apex of the roots. The elasticity of this mem-

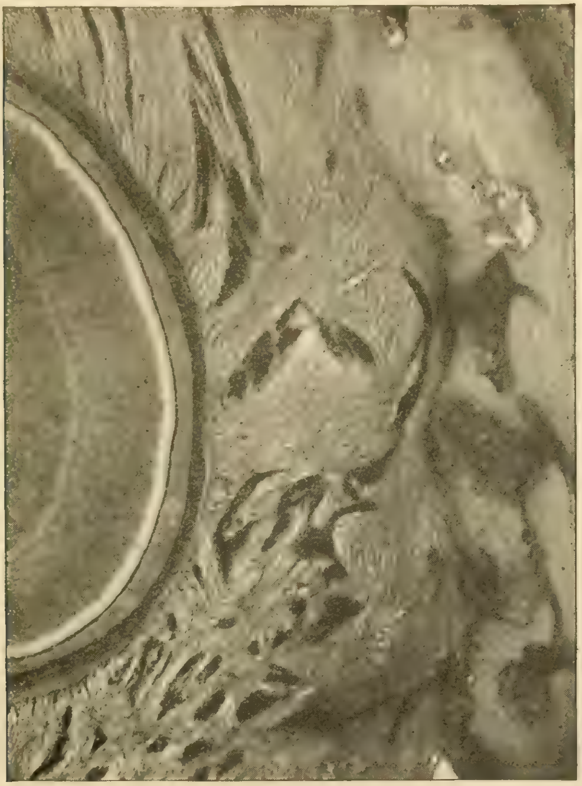

Fig. 25.

Cross-section of Root, Peridental Membrane and Alveolar Process. Radiation of Fibrous Tissue. (Noyes.)

brane is so great that in correcting irregularities a tooth may be turned from one-fourth to one-half around without breaking the fibers, Fig. 25. The elasticity is greatest in youth. As age advances the membrane grows thinner and thinner until, late in life, there is almost a bony union between the tooth and

the alveolar process, thus preventing stretching of the fibers. At the upper border, under the gum tissue these fibers extend over the edge of the alveolar border and unite with the fibers of the periosteum on the outer border of the process, forming the interstitial tissue.

Fig. 26.

X300. No. 2. Projective Ocular D.D., obj. Zeiss. Absorption of Alveolar Process. I, Fibrous Tissue, originally Bone. O, Lacunar Absorption.

If absorption of the inorganic substance of the alveolar process occur, the fibrous tissue retains the shape of the process. The same results when inflammation of the peridental membrane takes place at the gum margin or at the apex of the root of the tooth. What was once alveolar process is now peridental

membrane or fibrous tissue, Fig. 26. When pressure is applied in regulating teeth, the lime salts are absorbed and the results are obtained.

Two kinds of structures are present in the alveolar process, a dense, compact, hard structure (composed of lime salts) and a fibrous tissue; either alone will retain the shape of the alveolar process.

Blood-vessels permeate this membrane throughout from the gum tissue at the neck of the tooth through the alveolar walls to the end of the roots. They are most abundant in youth. Capillary blood-vessels (vessels of von Ebner) enter the bone and Haversian canals through the process and into the peridental membrane. Many of these blood-vessels extend the entire length from the gum margin to the apex in straight lines and vice versa. A great supply of blood-vessels penetrates the membrane through the alveolar walls. These vessels unite and anastomose with the arteries which traverse lengthwise, forming a complicated plexus. According to some writers the vascular supply of the peridental membrane is situated in the center of the structure. This has not been my experience. All of my slides as well as those here presented show the blood-vessels to be situated nearest the alveolar process. It is quite natural that this should be so, since very little blood is required for the nourishment of the cementum, while the largest amount is required to supply the alveolar process. The system of blood-vessels situated in the peridental membrane and showing their relation to the surrounding tissue can be well shown in injected specimen from healthy dogs.[4] The vessels seen in the membrane anastomose very freely with those at the gum margin, showing the membrane to be well nourished in all its parts. Should one part become involved by disease the other parts are over-nourished in consequence.

These blood-vessels enter the alveolar walls with the fibrous tissue through the Haversian canals and these in turn permeate the entire bone. As age advances, however, the bone becomes more dense and the Haversian canals become smaller and (under certain conditions) cease to exist. When disease takes

[4] Interstitial Gingivitis, page 40.

place, either at the gingivus or at the apex of the root, the supply of blood being thus cut off, the tissues receive sufficient nourishment through the alveolar wall. Since the structures are in a transitory state, being destroyed and repaired so frequently, it is evident why the blood supply is so rich.

As I have elsewhere shown an inflammatory process goes on not merely in the slightest movement of the teeth in regulating, but likewise in the eruption of the teeth as well as in absorption of the alveolar process after extraction. There is great individual variation from many causes in this particular. The amount of tension will, therefore, in a measure depend upon the individual idiosyncrasy. The operator must decide upon the extent of force to be applied in a given case. The influence of bending the alveolar process must depend to a greater or lesser extent upon the resultant absorption.

CHAPTER X.

DEVELOPMENT OF THE TEETH.

The teeth, as Minot remarks, were primitively organs of the skin and widely developed over the surface of the body. They played an important part in the development of the skeleton. The dermal bones, which form part of the skull, were originally teeth. The placoid scales, which were dermal teeth in the shark, helped out the deficiencies of brain case. This was cartilaginous and essentially the chondrocranium or primitive cartilage skull of the human embryo, formed from the vertebræ, but insufficient to cover the brain, ever increasing with evolution. The tooth is a papilla which projects into the epidermis and, ossifying (calcifying) in a particular way, changes into ivory around the soft core or pulp. To the papilla the epidermis adds a layer of enamel. The tooth proper departs from the primitive method of development since it does not arise on the surface but deep down. The dentiferous epithelium grows down into the dermis forming an oblique shelf, which is a special tooth forming organ. On the under side of the shelf the teeth are developed in the same way as over the skin although they are very much larger. The teeth are, however, in various stages of development and only one is fully exposed. When, as happens in time, it falls, the next tooth behind replaces it. Since the production of new tooth germs goes on in adult life, replacement of teeth in the shark's jaw continues indefinitely, hence sharks are termed polyphyodont. Mammals have but two sets of teeth and are called diphyodont. The teeth proper unite with a small plate of dermal bone at its base. By a modification of the jaws, the epidermis first grows into the dermis and the dermal tooth papilla is developed. The first indication of tooth germs in mammals is a thickening of the epithelium covering the jaw. This thickening, which appears as a ridge during the sixth week of embryonic life, forms on the under side of the epithelium. This curving ridge expands into an outer portion (the outline of the

groove between the lip and the gum) and an inner portion, the dental shelf which grows obliquely inward. The papilla for the milk teeth are formed on the under side of the shelf and it is thus possible to continue growing toward the lingual side so that the second set of germs is thus developed for the permanent teeth. The end of the shelf, toward the articulation of the jaws, is prolonged without retaining the direct connection with the epithelium and from this prolongation arise the enamel organs for the three permanent molars. Wherever a tooth germ arises, the dental shelf is locally enlarged and the local enlargement constitutes an enamel organ which projects from the under side of the shelf. Mammal teeth pass in evolution from the simple types of the oviparous edentates to those of the indeciduous ancestors of the sloths and armadilloes and their descendants, inclusive of the dolphins and whales, whose teeth (in the fœtal Greenland whale and adult Sperm whale) preserve this old type. While, as in the edentates, these teeth may be few, they may also, as in the insectivorous mammals, approximate those of the reptilia in number (sixty or seventy on a side) and characteristic location.

The evolution of this primitive tooth to the bicuspid and molar type results from, as I have elsewhere shown, concrescence and differentiation. The human lower molar with its low quadritubercular crown has evolved by addition of cusps and by gradual modeling from a simple high crown pointed tooth.

The tooth has, as Havelock Ellis[1] points out, been but little considered from anthropologic and ethnologic standpoints. Flower, however, has constructed a dental index by multiplying the dental length by 100 and dividing by the basio-nasal length (or length from the naso-frontal suture to the foramen magnum). According to his results thus obtained the white or Caucasic races are microdont (with small teeth and small dental index). The yellow or Mongolic races are mesodont (middle teeth and index). The black races are megadont (great teeth and index). The anthropoid apes have still larger indices and teeth.

In addition to the rudiments of the enamel organs for the milk and permanent teeth, there are addtional organs often

[1] Man and Woman.

present in a very variable condition and number nearer the external surface, and are exceedingly similar to the youngest stages of the normal enamel organs. According to Kollmann and Gegenbauer they are abortive rudiments, survivals from an ancestral condition in which teeth are more numerous.[2] Black[3] speaks of these as glands, while Ch. Robin and Magitot,[4] who were the first to describe them, claim they are epithelial débris; a view perfectly compatible with that of Gegenbauer and Kollmann. My own researches[5] corroborate the results of Robin and Magitot.

[2] DeMoor, Evolution by Atrophy.

[3] Dental Cosmos, Feb., 1899.

[4] Genesis and Development of the Dental Follicle, Journal de Physiologie de Brown-Sequard, 1860.

[5] Interstitial Gingivitis.

CHAPTER XI.

SOCIAL CONSANGUINITY, NEAR-KIN, EARLY AND LATE MARRIAGE.

From the general principles of heredity already laid down it must be obvious that the influence of intermarriage in families has been over-estimated as a factor per se in producing defect. The idea of the advantage of cross-breeding, which seemingly appeared in the practice of exogamy (marriage outside the tribe or more often outside those having the same totem or coat-of-arms) arose, as I have elsewhere shown,[1] from observation of deformities, following intermarriages contracted after the killing of girls for economic reasons had led to exogamy. The idea of incest[2] was of religious origin rather than innate, since totemic relationship (which was chiefly prohibited) was often far from being consanguinous. The totem was a mark indicating descent from a supposed animal ancestor endowed with occult powers. The children with the Bear totem of one tribe could not marry those having the Bear totem of any other tribe. From this practice sprang the medical, theologic and legal notions anent the danger from marriages of consanguinity, which, as D. Hack Tuke[3] remarks, insisted upon from time to time by medical writers, has been recognized by ecclesiastic authority, civil law and by popular feeling. By ecclesiastic and civil law, marriage of those very nearly related has been forbidden on other grounds than that of alleged danger to offspring. At the same time the justice of such laws receives support from medical observations, which tend to show that intermarriage may produce degeneracy, idiocy and insanity. I have elsewhere analyzed[1] this evidence and shown for the facts there is more than one explanation. The explanation pointed out by Strahan[4] underlies the chief danger in intermarriages. With a perfectly

[1] Degeneracy: Op. Cit.

[2] Durkheim Année Sociologique, 1898.

[3] Psychological Dictionary.

[4] Marriage and Disease.

healthy stock, as every breeder of animals knows, remarks Strahan, "in-and-in breeding" may be practiced with impunity, but where the stock is tainted with disease or imperfection, safety is only to be found in "crossing."

The error of the old doctrine upon which was founded the prohibition of consanguinous unions lay, as Strahan remarks, not in asserting that disease and deformity were more often met with in children of these than those of other unions, for such is the fact, but in attributing these unhappy results merely to parental blood kindred. Over and above the fact that these consanguinous marriages are almost certain to transmit, in an accentuated form, defect or tendency to disease already present in the family, there is no physiologic reason why such marriages should not take place. Breeders of prize stock frequently breed "in-and-in" not only with impunity but with marked benefit. But this fact, while going to prove that it is not the mere blood relationship of the parents which induces the degeneration so often found in the children of consanguinous marriages, can but rarely be advanced as an argument in support of the marriage of blood relations. The stock-raiser only permits the more perfect members of his flock and herds to continue their kind; for this reason "in-and-in" breeding is innocuous just as it would be in the human family under like conditions.

Recently acquired characters, whether physiologic or pathologic, are very liable to disappear when the individual bearing such characters intermarries with another not having the same character. The natural tendency in all such cases is to revert in the offspring to the normal type, so that unless the new character be very deeply impressed upon the parental organism, it is almost certain it will not appear in the offspring of the other parents having nothing of the character. But when both parents are possessed of the character, whether it be physiologic or pathologic, this natural tendency to revert to the original is often overborne and the character is repeated in an accentuated form in the offspring.

Now this accentuation of family characters is what must always happen in the case of consanguinous marriages. If there be taint in the family, each member will have inherited more or

less of it from the common ancestor. Take the case of cousins, the descendants of a common grandparent who was insane and of an insane stock. Here the cousins are certain to have inherited more or less of the insane diathesis. Even if the taint have been largely diluted in their case by the wise or more likely fortunate marriages of their blood related parents, yet, still they have inherited a certain tendency to nervous disease and if they marry they must not be surprised if that taint appear in aggravated form in their children. Some children of such parents are idiotic, epileptic, dumb or lymphatic and the parents marvel whence came the imperfection. In some cases the parents and possibly grandparents of the unfortunate children have not displayed any obvious evidence of the tendency to disease which they have inherited and handed on to their descendants. Not looking farther back the parents boldly assert that such a thing as insanity, epilepsy, scrofula, etc., is unknown to their family. They, themselves, have never been insane; why, then, should their children? In like manner children may be epileptic, blind, deaf-mute, lymphatic, cancerous, criminal, drunkards or deformed from direct inheritance and yet the family line be honestly declared to be healthy. The truth of Sir William Aitken's maxim (that "a family history including less than three generations is useless and may even be misleading") is hence obvious. Similarity of temperament induced by a common environment which Strahan calls "social consanguinity" is, hence, also a potent factor in the production of all hereditary degenerations. Living under similar customs, habits and surroundings, laboring at the same occupation, indulging in the same dissipation, tend to engender like diseases and degenerations irrespective of any blood relationship. Hence, it not seldom happens that persons not even distantly related by blood, are in reality much more nearly related in temperament than cousins or even nearer blood relations who have experienced widely different modes of life. This "social consanguinity" is the great curse which dogs every exclusive tribe and class and hurries them to extinction. It has largely added to real or family consanguinity in the production of the disease and degenerations which have so heavily fallen upon the aristocracies and royal families of Europe.

This "social consanguinity" appears likewise in the tendency of the neurotic to intermarry, popularly expressed in the proverb that "like clings to like." This likeness which is in mental characteristics has been shown to be present by Roller, de Monteyel, Kiernan, Bannister and Manning, so far as Germany, France, the United States and Australia are concerned. Bannister puts the statistic proof of this tendency thus forcibly: "There are in Illinois, according to the most recent estimates, in round numbers, about 6,000 insane, or one to a little over 500 of the population. Even if we double, treble or quadruple this frequency to include all that have been or are to be insane, as well as those insane at the present time, it would not appear that there was much probability of two insane persons being married according to any ordinary law of chances. In fact, we find four out of the 104 with insane heredity had both father and mother been insane. In one of these cases the insane heredity involved both parents and grandparents on each side, though in the case of the latter the histories show it only as collateral. Besides these three patients direct paternal and collateral maternal heredity, two had direct maternal and collateral paternal heredity and in one case there was collateral heredity of insanity on both sides. This makes altogether nearly 10 per cent of those with insane heredity with it on both sides, maternal and paternal, and thus favored with a double opportunity to inherit mental disease. If to this be added the instances where with insanity of one parent there is either epilepsy, hysteria, or drunkenness, brain disease, nervousness, etc., of the other, the ratio of double inheritance rises to over 20 per cent."

Since jaws and face are transitory structures, but relatively little taint is needed in a family or community to cause degeneration of the face and jaws and irregularities of the teeth. The influence of this factor of these neurotic and "social consanguinity" tendencies in the production of deformities of the face and jaws and irregularities of the teeth cannot well be over-estimated. A test of these influences is alleged to exist in the Polynesian populations of the Pacific Islands, where race admixture can be excluded for a relatively long period. Concerning the ancient

Hawaiians, J. M. Whitney[5] remarks: "Here is a people isolated from all others for at least 1,400 years with no admixture of races, yet irregularity of the teeth of both maxillæ is almost as common as it is among the mixed races of to-day." In social consanguinity of the Polynesians must be peculiarly reckoned their excessive and systematized licentiousness, shown in societies for practice of extreme sexual indulgence, like the Areoi.[6] Such societies undoubtedly create neurotic states and tendencies and produce more marked degeneracy of the face, jaws and teeth than intermixture of race or consanguinous marriage. The factors of race admixture cannot, as Denniker[7] has shown, be completely excluded from consideration among the ancient Hawaiians. Since leprosy, like syphilis, may simply check development without causing infection in utero, this factor has likewise to be taken into consideration. Furthermore, as Alvarez,[8] of Waialu, Dahu, has shown, the mortality among Hawaiian babes is very large. Hygiene is practically unknown to the mothers. Kava-Kava (the fermented juice of the ava) is the great medicinal agent of the Kahuna (sorcerer-medicine man), who is the chief medical resource of the natives. Syphilis is very common, especially the non-venereal type. The habits of the natives aid the spread of the disease. Under such conditions, irregularities must result. The age of the mother at pregnancy is too much ignored in dealing with defects. J. Mathews Duncan[9] pointed out nearly two decades ago that the offspring of early and senile marriages were defective. Multiple and too nearly repeated pregnancies were of frequent occurrence. Conger[10] (whose results were later corroborated by Joseph Workman[11] and Kiernan) points out that in all degenerate forms, age of the parent must be taken into consideration, since it alone often determines degeneracy. Conger found that the age of the mothers of degenerates is often below twenty-five years. Korosi,[12] in an investigation

[5] The World's Columbian Dental Congress Transactions, page 109.

[6] Schultze: Fetichism.

[7] Races of Men.

[8] Pacific Medical Journal, 1893.

[9] Sterility, Fecundity and Allied Topics.

[10] Il. Manicomo, May, 1886.

[11] Alienist and Neurologist, 1887.

[12] Orvosi Hetilap, 1894.

of the influence of the age of parents on the vitality of children found that the proportion of deaths among children from unhealthy constitutions or maladies traceable to the mother was twice as large among the children of mothers under twenty as among the children of mothers over thirty. The healthiest offspring are born of mothers between twenty and thirty, united to husbands between thirty and forty. Where either husband or wife was under twenty, the offspring usually proved weakly. This is particularly the case even in Hungary, where the girls become women at thirteen. In that country in 25 per cent of the number of marriages the brides are under twenty years of age.

Marro[13] finds that among all classes of criminals there is an excess of immature parents (under twenty-five) or senile parents (over forty-two). As I have elsewhere remarked, it is a well known experience that the children of the aged readily show degenerate types.[14] Arthur Mitchell and Langdon Down have recognized the influence of both premature and late marriage in the production of idiocy. Factors capable of producing idiocy may arrest fœtal development at all stages. Kiernan[15] has had under observation a Nova Scotian family of Scotch extraction, the mother of which continued to bear children until she was sixty-three years old. There had been no pregnancy between fifty and fifty-six. At fifty-six a son was born who had ear, jaw and skull stigmata and became a periodical lunatic at twenty-five. A son born a year after was a six-fingered idiot with retinitis pigmentosa. Three of the next children were paralytic idiots in infancy. One of the next children was a periodical sexual invert female. The last child was an epileptic. The children born before the age of fifty were normal and averaged sixty years of age.

[13] La Puberta, 1898.

[14] Degeneracy, Op. Cit.

[15] Detroit Lancet, 1882.

CHAPTER XII.

ENVIRONMENT, CLIMATE, SOIL AND FOOD.

The influence of climate, soil, food and other factors of the immediate environment was obvious to very early observers. According to Hippocrates,[1] "race is the daughter of climate." The seeming modifications produced have made an impression even on skeptical biologists like Weismann,[2] who admits that "the possibility is not to be rejected that influences continued for a long time (that is, for generations, such as temperature, climate, kind of nourishment, etc.,) which may affect the germ plasm as well as any other part of the organism, may produce a change in the constitution of the germ plasm. But such influences would not then produce individual variations, but would necessarily modify in the same way, all the individuals of a species living in a certain district. It is possible, though it cannot be proved, that many climatic varieties have arisen in this manner. Possibly other phenomena of variations must be referred to a variation in the structure of the germ plasm produced directly by external influences."

The influence of climate depends upon more than the mere range of temperature and meteorologic elements. Transferral from a sub-temperate to a sub-tropic clime means not merely a change in the necessity for adaptation to temperature alterations, but also change in the ease with which food is produced and the stress of the struggle for existence to which man has been exposed. One of the most interesting changes apparently due to the influence of soil and climate was that of the Wurtemburgers, who settled 82 years ago near Tiflis, Russian Georgia.[3] They originally had fair or red hair, light or blue eyes and broad coarse features. In the first generation, brown hair and black eyes became the rule, while the face acquired a noble, oval

[1] Works Sydenham Edition.

[2] The Germ Plasm.

[3] Keane, Ethnology, page 283.

form. These changes were due entirely to the surroundings, as no instance of crossing with Georgian neighbors was on record. These Wurtemburgers continued to speak German uninfluenced by local dialects. The Suabians, however, were a mixed race in whom the surroundings in Wurtemburg tended to develop one type while those in Georgia tended to develop another. The changes in the face, jaw and teeth consequent in these changes in type became clearly evident. The original Wurtemburger type had arrested facial development and prognathism, which disappeared under the favorable conditions of Russian Georgia. The instance illustrates very clearly the changes which have produced the alleged transformation of the Britisher into the Yankee, commonly cited in illustration of the supposed effects of soil and climate. Over three decades ago,[4] Vogt remarked that American Anglo-Saxons or Yankees were instanced as illustrations of change of character. Already after the second generation, according to Pruner-Bey, the Yankee presents features of the Indian type. At a later period the glandular system is reduced to the minimum of its moral development. The skin becomes like leather. The color of the cheeks is replaced by sallowness. The head becomes smaller and rounder and is covered with stiff, dark hair. The neck becomes longer. There is greater development of the cheek bones and the masseters. The temporal fossæ become deeper, the jawbones more massive, the eyes lie in deep approximated sockets. The iris is dark. The glance is piercing and wild. The long bones especially in the superior extremities are lengthened so that the gloves manufactured in England and France for the American market are of a peculiar make with long fingers. The female pelvis approaches that of the male. According to Quatrefages, America has thus from the English race produced a new white race which might be called the Yankee race. This hypothesis has of late been strongly urged before the Chicago Academy of Medicine by F. W. Starr, Professor of Anthropology in the University of Chicago, but no new facts favorable to it have been adduced.[5] With improved conditions in New England this

[4] Lectures on Man, 1869.

[5] Journal of the American Medical Association, Vol. XXXV.

accentuation, however, began to disappear. In place of the New England type assuming increased Indian characteristics, the reverse became the case. In the following illustration, four generations of a New England family with a Scandinavian patronymic are represented. The changes are as striking as those which occurred in the Suabian before mentioned. The first generation (born in 1761) is represented by a dolichocephalic head (Fig. 27) with massive jaws and lips (especially the upper) prominent. The nose is long. The eyes are set close together. The forehead is very high and straight. In the second genera-

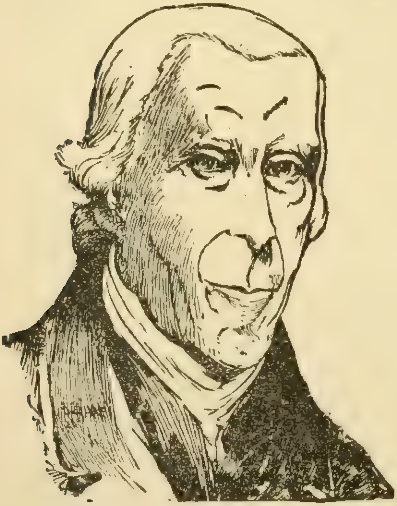

Fig. 27.

Fig. 28.

tion (Fig. 28) the face is not so long. The lateral diameter is larger. The forehead is more prominent. The eyes are a little farther apart. The nose is about the same length. While there is a general resemblance about the mouth and chin, the distance from the front of the chin to the tip of the nose is not quite as long. In this the shortening of the chin has played apparently the chief part. In the third generation (Fig. 29) the forehead is broader and less retreating than in the second. There is less prognathism and less prominence in the supra-orbital region. In the fourth generation (Fig. 30) appears a brachycephalic type of head. It is nearly round. The forehead is full. The eyes are

set in the head to correspond with its width. The nose is broad. The upper lip is short. The lower jaw is much broader than in the first generation and is evidently shorter in a perpendicular line. These changes result from the formation of a protruding forehead, receding chin and delicate features.

In the influence of climate must, however, be taken into account, as already stated, modes of life. The distinction once made by anthropologists between tropic and non-tropic races is no longer tenable in a rigid sense. Experience of the British in India and of the Hollanders in Java has shown that with

Fig. 29.

Fig. 30.

change of habits and food suited to the environment,[6] Europeans may not only live in the tropics with impunity but may improve under the advantages these have over sub-arctic and temperate zones.

These possibilities are the consequence of sound sanitation. "The fairest laurel practical hygiene may boast of to-day is doubtless the laurel acquired," Gihon[7] truthfully remarks, "in ameliorating the sanitary conditions of the Europeans in tropical climates." It proves the truth uttered a century ago by James

[6] Degeneracy, Op. Cit.

[7] Sajous Annual, 1892.

Lind, "much more than to the climate, you are indebted to your own ignorance and negligence for the disease from which you suffer in tropical climates."

Modern researches not entirely supporting the Hippocratian declaration, tend to show that the vital resistance of the different races in tropical climates depend more on external conditions than on race. Acclimatibility of strong, healthy adult Europeans of both sexes in tropical climates must be admitted without reserve, provided that they assiduously observe hygienic rules. Stokvis has disproved the allegation that the European is not able to produce in tropical regions more than three or four generations of true European blood, and that from the third or fourth generation onward sterility is the rule. With the permanent establishment of an American colony in the Philippines these facts will be re-enunciated.

Among important factors to be considered in connection with hygiene in the tropics are the questions of dietetics as well as the effects of moist and dry heat. The two last produce, as elsewhere shown, a neurasthenia with co-existing and complicating auto-intoxication. These[8] two would peculiarly affect the alveolar process.[9] It is, therefore, not remarkable to find in a recent report by General Otis, the case of Walter Fitzgerald, Company C, twenty-eighth infantry, formerly of the Montana volunteers, cited. This twenty-three year old man has been in the Philippines for a year and seven months. He was one of the first volunteers to reach Manila after the naval battle. Nineteen months' life in the tropics on the usual army rations has resulted in the loss of nearly every tooth. While the climate undermines nutrition of the alveolar process, and tropical fevers have the same effect, improper diet increases the defect. In the case of Fitzgerald, the teeth dropped out one by one, as is commonly the case with Americans in the Philippines.

The English speaking race, albeit it is peculiarly representative of the upper temperate races, has shown itself able to endure all climates. The type now forming in South Africa and Aus-

[8] Interstitial Gingivitis: Transactions, Section on Stomatology, American Medical Association, 1900, page 127.

[9] See Interstitial Gingivitis.

tralia recalls the early New England and Kentucky type of the 18th century, but will doubtless pass like it into a type resembling that of the fourth generation illustrated. This race has in its own home been peculiarly mixed. In its colonies it is still more so, but despite this, preserves relatively permanent mental and physical racial characteristics. The struggle to maintain the mental state produces the variations in the teeth and jaws noticeably present in the English speaking races. The Scandinavian nations, who resemble them in racial admixture and adaptability to climate, have the same tendencies.

That climate does not exert the influence once claimed for it is singularly well shown in Minnesota, where, thirty years ago, government authorities claimed it was impossible for human beings to live the whole year owing to extreme cold in winter. Now not only is the soil cultivated throughout the entire state, but still further north in Manitoba a large city has sprung up surrounded by a very considerable farming population. The influence of climate, therefore, can be guarded against by man much more than any factor of his environment.

The influence of altitude on the physiologic characteristics, while very obvious at times, is, however, frequently absent. While as a rule residents at high altitude are strong, robust, buoyant and of great mental and physical endurance, there are numerous exceptions.

Hafner,[10] of Zurich, has recently shown that "the engineers and workmen on the Jungfrau railway obliged to remain a considerable time at altitudes of about 2,600 meters above the sea level are liable to a disagreeable complaint. After eight or ten days they are seized with violent pains in several teeth on one side of the jaw, the gums and cheek on the same side becoming swollen. The teeth are very sensitive to pressure, so that mastication is extremely painful. These symptoms increase in severity for three days and then gradually and entirely disappear. It seems to be purely a phenomenon of acclimatization. All newcomers pass through the experience and the disorder never recurs." The influence of heat, of cold and of the barometric pressure shown in a lesser degree in "mountain fever" produce

[10] Die Natur, 1900.

systemic disturbance of metabolism which, causing auto-intoxication, markedly affect the alveolar process, producing interstitial gingivitis.

The effects of soil upon bone growth are best illustrated in those associated with goitre and cretinism. Researches among Indians on reservations tend to show the influence of high altitudes; climate or water containing excess of calcium-magnesium salts, has been over-estimated. Among the Indians unsanitary surroundings, depressing constitutional conditions, improper and excessively nitrogenous diet, largely produce goitre and bone changes often associated with it.

The influence of food in producing systemic changes which involve interference with proper osseous development may be divided into two factors. One involves the quality of the food and the other its quantity and variety. One very emphatic illustration of the first factor is the constitutional, skin, nervous and mental disorder known as pellagra. This condition has received much attention from French and Italian physicians. While unhygienic surroundings play a part, pellagra[11] is chiefly due to spoiled maize taken as a food. The frequency with which jaw and teeth stigmata are found with pellagra demonstrates how potent is this factor of improper diet. Monotony of diet is likewise a very emphatic cause of constitutional nervous disorder, such as distort osseous development. Monotony of diet, as I have elsewhere shown,[12] aggravated by monotony of surroundings, has undoubtedly produced a large amount of degeneracy in the families of pioneers in the United States and of farmers in secluded valleys in Norway, Switzerland and elsewhere. Ray, Brigham of New York, Awl of Ohio, Patterson of Illinois, and H. M. Stearns of Connecticut, have shown that there is an unusual quantity of insanity in farmer's wives traceable to these conditions. A case reported by Kiernan, of Chicago, is typical of those earlier described by the American alienists just cited. The first generation was a woman of New England stock, of tireless energy, to whom work was a pleasure and rest an abhorrence and who lived on a farm miles from the

[11] Billod Pellagra.

[12] Degeneracy, Op. Cit.

town. She did all her own work and brought up a large family, chiefly on maize, potatoes and bread, pork being the meat diet. At fifty this woman removed with her husband, who had grown wealthy, to a small country town. Here she conducted the entire work of the household without a servant. At fifty-two she broke down with neurasthenia, which rapidly passed into periodical gloomy spells, in one of which she committed suicide. Her youngest daughter, who had an asymmetrical face, has the periodical gloomy tendency of the mother alternating with periods of restlessness, which evince themselves in doing unnecessarily the work of the servants and other labors inconsistent with her huband's social status. She had at times suicidal and homicidal impulses. She has three children; one exhibits no special abnormality; the eldest, a boy of eleven, dislikes to play with boys because they are rough, plays with girls, to whom he is at times mischievously cruel. He likes to sew doll's clothing and purchase dolls, while there are other indications of sexual abnormality. The youngest, a girl, has frequent attacks of epileptic-like fury, although between these she is kind-hearted, good humored and very affectionate.

The fungus on maize (ustilago) like the fungus on rye (ergot) produces rather long lasting neuroses of epileptic character, susceptible of transmission to the offspring of women poisoned by the fungi.

The infiuence of vegetarian diet seems to be deteriorating to the races who are restricted to it alone. These races are usually cowardly, meanly cruel, extremely mendacious, untrustworthy, weak in stamina and readily yield to morbid influences.

The influence of potato diet in degenerating the Irish Celt in comparison with the Scottish Celt under the same conditions is difficult at present to determine for lack of data. Certainly the descendants of this class of Irish Celts rapidly regain a handsome, healthy status under mixed American diet, even though the hygienic surroundings in the great cities be not the best. He who has to treat a class of neurasthenics in whom starch digestion is impaired finds that a diet of potatoes (undoubtedly through the auto-intoxication it produces) will increase certain nervous symptoms and hence the tendency to

transmission to the next generation. The widespread influence of nutrition is excellently illustrated in the conditions produced in children and in the insane, by improper food and the reaction of these to hygienic diet. Improper diet in the child may, as Christopher[13] has shown, produce all possible nervous disorders, including those involving the trophic processes. This is peculiarly evident in scurvy and rickets and their effects on the general osseous development. Improper maternal diet during pregnancy may, as Elise Berwig[14] has shown, produce similar effects.

The influence of the maternal environment upon the fœtus has been much underrated because of the belief that the placenta, by its filtering and poison-destroying function, protected the fœtus. That this was an error in many respects has been already shown by the arrests of development produced by the toxines of the great contagions. It, however, justified for a time hazardous occupations for pregnant women. Later investigation showed that not only did organic poisons, like opium, pass through the placenta, but that mineral poisons, like lead, did also. Calkins,[15] nearly four decades ago, pointed out that the children of opium-using mothers died in the first months after birth unless given opium. Bureau later showed that in such cases the umbilical cord contained large quantities of morphine.

Many years ago it was known that the children of the workers in tobacco factories exhibited very little vitality and much deformity.[16] As tobacco is a government monopoly in France an attempt was made to destroy this opinion by a cooked report from the Imperial authorities. The evidence, however, from other sources contradicted this report and the latest investigations in France (those of Etienne[17]) strongly support previous opinion that maternal work in tobacco factories is, as I have elsewhere shown,[18] the cause of frequent miscarriage, of high infantile mortality, of defective children and of infantile convul-

[13] Cited in Degeneracy, Op. Cit.

[14] Medicine, 1898.

[15] The Opium Habit.

[16] Annual of the Universal Medical Sciences, 1892.

[17] British Medical Journal, April 23, 1898.

[18] Degeneracy, Op. Cit.

sions. The influence of mineral poisons has been carefully studied by Porak,[19] who has found that lead and phosphorus pass through the placenta and enter the child's circulation. Lead, as I have elsewhere pointed out, has been found to produce in those exposed to its fumes systemic nervous exhaustion, characterized by local paralysis about the wrist as well, as the general symptoms of profound systemic nerve tire. This may result, as Tanquerel des Planches[20] pointed out nearly half a century ago, in acute insanity of the confusional type followed very often by forms of mental disorder of a chronic type resembling paretic dementia. In some cases the patient recovers from the acute insanity to suffer thereafter from epilepsy. In other cases, as Kiernan has shown,[21] an irritable suspicional condition results in which the patient may live for years, marry and leave offspring. This last condition and the epileptic are the most dangerous as to the production of degeneracy. As already pointed out,[22] the women employed in the pottery factories in Germany suffer, according to Rennert,[23] from a form of lead poisoning which produces decidedly degenerative effects upon the offspring. These women had frequent abortions, often produced deaf-mutes and very frequently macrocephalic children. On investigation of the Staffordshire potteries,[24] similar conditions have been observed. Kiernan[25] has reported the case of a macrocephalic idiot born of a mother who had lead poisoning while a worker in a Staffordshire pottery. Brass workers, as I have pointed out some years ago, suffer from a very similar condition to that produced by lead. Hogden,[26] of Birmingham, over half a decade ago, called attention to the grave forms of nervous exhaustion produced among brass workers. His results have since been confirmed by German and other observers.[27] The period during which the patient is able to pursue

[19] University Medical Magazine, 1895.
[20] Lead Diseases, American Edition, 1848.
[21] Journal of Nervous and Mental Diseases, 1881.
[22] Degeneracy, Op. Cit.
[23] American Journal of Obstetrics, 1882.
[24] British Medical Journal, August, 1900.
[25] Obstetrics, Feb., 1900.
[26] Birmingham Medical Review, Jan., 1887.
[27] Medicine, 1901.

his occupation without breaking down is longer than that of the lead workers. Women, like men, are exposed to this condition. The chief effect produced so far as offspring has been observed are frequent abortions and infantile paralysis.

The occupations employing mercury (whether mining, mirror making or gilding) produce systemic nervous exhaustion in which the most marked symptoms (but less important from a sanitary standpoint) is a tremor amounting at times to shaking-palsy. Like all other systemic nervous exhaustion, the mercurial one may appear as degeneracy in the offspring. The employment of women in match factories and tenement house sweating shops is growing. The chief toxic effects of phosphorus is not the localized jaw neurosis. This is but an evidence of the progressive system saturation with phosphorus. It bears the same relation to the more dangerous effects of phosphorus that "blue gum" does to the systemic effects of lead.[28]

Workers in carbon bisulphide have been noted to suffer from the initial stages of interstitial gingivitis. Lazarus[29] has recently reported the cases of twenty young women employed in rubber factories who exhibited a necrotic process in the jaws and teeth similar to that resultant on phosphorus.

[28] Degeneracy, Op. Cit.

[29] Allg. Med. Cent. Ztg., Dec. 22, 1900.

CHAPTER XIII.

RACE ADMIXTURE.

Race admixture has been greatly underestimated. Ethnic researches of the past decade have thrown much doubt on the standards set up as race tests.

It is usually assumed a clear distinction can be made on philologic grounds between different races, and even Aryan races can be easily separated. This, however, ethnology has shown to be an error. The following table, modified from Keane, demonstrates that speech is no test of race:

Peoples.	Ethnic Group.	Linguistic Family.
English and Lowland Scotch.	Kelto-Teutonic	Teutonic
Cornish	Silure-Kelto-Teutonic	Teutonic
Welsh	Silure-Kelto-Teutonic	Keltic
Scotch (Highland)	Silure-Kelto-Teutonic	Keltic
Irish (West)	Silure-Kelto-Teutonic	Keltic
French	Ibero-Kelto-Teutonic	Italic
Spaniards	Teuto-Ibero-Keltic	Italic
Germans	Slavo-Kelto-Teutonic	Teutonic
Bohemians	Kelto-Teuto-Slavonic	Slavonic
Russians (many)	Finno-Slavonic	Slavonic
Fins (many)	Teuto-Slavo-Finnic	Teutonic
Bulgarians	Ugro-Slavonic	Slavonic
Hungarians (Magyars)	Ugro-Teuto-Slavonic	Finnic
Prussians (East)	Letto-Teuto-Slavonic	Teutonic
Roumanians	Italo-Slavo-Illyric	Italic
Italians	Teuto-Liguro-Kelto-Italic	Italic

Profoundly mixed as this table indicates European races to be, it is far from representing, as I have elsewhere[1] shown, the full extent of race mingling. The primitive worship of the Slavonic Czernebog by the Saxons in England demonstrates a Slavonic strain derivable, as Kiernan suggests, from their contact with the Wends of the Baltic. Not merely are the Aryan races of Europe mixed together, but the blood of all has a pre-Aryan

[1] Degeneracy, Op. Cit.

and a Turanian dash. As Taylor,[2] Windle[3] and others have shown, the Iberian type is found in Wales and Scotland as well as elsewhere, though in lesser degree. These admixtures date back to palæolithic times when, although the predominant type of skull was dolichocephalic (or long-headed), the brachycephalic (or round-headed type) had begun to appear in America, then connected by land with both Africa and Europe. In subsequent neolithic times, while the type is at first generally brachycephalic, it soon becomes mesocephalic (mixed long and round-headed), pure brachycephalic and dolichocephalic becoming rare.

As Starr[4] admits, even the race type called the American Indian still so retains traces of the race elements forming it in the pleistocene period that these elements are yet distinguishable by ethnologists. In nose types the American Indian race leans toward its proto-caucasic rather than its proto-mongolic or proto-negroid elements.

Three types appear in Great Britain and Ireland and traces of their blood are still detectable in living men. Sir Walter Scott draws an excellent picture of one in "Rob Roy," whose hero, according to reliable tradition, presented the Pict type. Gomme[5] has shown these races persisted long enough to stamp their savage beliefs on coming races and intermingled with them. The Neolithic race in Great Britain was dark, of feeble build, short stature, with dolichocephalic skulls. This race remained to the historic period as the Silures in Great Britain and the Firbolgs in Ireland. It had high cheek bones and oblique eyes, as Kiernan[6] points out. Towards the middle of the neolithic period this race was conquered by a brachycephalic, tall, long-armed, muscular race, with florid complexion and yellowish or red hair. Scott's "Rob Roy" is an example of this type. A third race of fair complexion with prognathous jaws, dolichocephalic skulls, of tall stature, great bones, great chest development and massive jaws, later invaded Great Britain.

As the intermingling of races began early, the question of

[2] Origin of the Aryans.

[3] Life in Early Britain.

[4] Journal of the American Medical Association, Dec. 15, 1900, p. 1575.

[5] Ethnology in Folklore.

[6] Alienist and Neurologist, 1891.

the existence of pure races to-day, or even during the historic period, is an open one. The Hebrews have been comparatively pure since the return from captivity. Before that, as the history of Solomon's foreign marriages demonstrates, they were, as Laing shows, a raceless chaos, the Semitic element predominating.[7] Researches by Flinders Petrie and others indicate that the Copts or ancient Egyptians were a mixture of Turanians, Hamites, Aryan and Semite peoples imposed on a negroid basis. When these elements were finally fused, the race bred relatively true, although the lower classes tended to the negroid type and the higher to the Caucastic.

The Coreans are a mixture of two primitive races, one white and one yellow. The Japanese, whose ancestors emigrated to Japan from Corea, are, according to Topinard,[8] the product of the addition of three distinct types to that forming their Corean ancestors. The Caucasic, to a small extent, The Polynesian to a greater, and the Malay to a still greater, are mixed with the original Corean.

The Chinese are neither a homogenous people nor a pure race, albeit the relatively few Mantchus are dominant. The Aryan of India, on whom Max Muller laid such stress, is known to be, despite a rigid caste system, a non-Aryan race, feebly infused with a modicum of Aryan blood. The so-called "Gypsy" seems of all the races of India to have retained most Aryan speech and type as well as original Aryan semi-nomadic wagon-journeying in the midst of settled civilization. Ghetto seclusion long helped to preserve relative purity of race in the Jew, but despite vagabond surroundings the "Gypsy" has remained even purer.

Great as has been the mixture of even widely separated types like three races described as mingling in Great Britain and Ireland, even greater admixture occurred in comparatively late historic times. The so-called Scotch-Irish (whose blood enters so largely in the dominant race of the United States), despite their speech (much more Teutonic and monosyllabic than English) are, as Kiernan has shown, a raceless chaos of Gaelic and Cymric Celts,

[7] Human Origins.
[8] Anthropology.

Lowland Scotch, French Huguenots, Danes (Celto-Teuto-Slaves), Palatinate Germans, Magyars, English Puritans, Hollanders, Swedes, Protestant Italians, Poles and Spaniards. The intermixture of the dark, small-boned dolichocephalic, orthognathous (with in-drawn jaws) race with the brachycephalic, prognathous, big-boned, red-haired, and then with dolichocephalic, prognathous, deep-chested, big-boned fair race, produced in the British Isles as marked variations in type as now occur from the admixture of the Indian and the Negro. While religion played a part in these admixtures in the British Isles, war, commerce and art also exerted an influence. Bunyan, the author of the "Pilgrim's Progress," was the descendant of Bunyano,[9] an Italian architect, imported to build Melrose Abbey. The destruction of the Spanish Armada introduced Spanish elements all along the West and East coasts of England, Ireland and Scotland. The capture of Calais by the French from Mary Tudor added a French colony to London.

In Scandinavia (Denmark, Norway and Sweden), race admixtures, although less discussed, are as great as those in the British Isles. The primitive race called the Quens was of Eskimo type. This race was first intermixed with a tall, long-armed, brachycephalic, muscular race with florid complexion and yellowish or red hair. The race resultant on this mixture was later fused with a third having prognathic jaws, large dolichocephalic skulls, tall stature, great bones, great chest development but small hands and high arched feet. After these race admixtures had formed the Scandinavians, who became the sea kings, the intermixture with other races still continued. Around Bergen, Norway, was, as Mantegazza[10] points out, an Irish colony with well-formed, delicate features, brunette complexion, oblique blue eyes and black hair. The influence of this colony is still so demonstrable as to be frequently used in fiction by writers like Bjornson.[11] As there were different types of skull and face among the races making up the English-speaking and Scandinavian-speaking peoples, the contest for existence (between the

[9] Notes and Queries, 1883.

[10] Physiognomy.

[11] "In God's Ways."

organs of man) centered itself with peculiar intensity on structures which, like the jaws and teeth, are so variable with a rise in the scale of evolution. The scion of an orthognathic mother and prognathic father would have marked irregularity of the jaws and teeth destitute of the significance of the depth of degeneracy implied by the same irregularities in a purely prognathic or orthognathic race. Food which exacted less active functions on the part of the jaws and teeth in such a mixed race would imply an intense struggle for existence between the different teeth and this struggle and would proceed with greater or lesser intensity as the organism was or was not affected by that constitutional nerve strain, which precedes general degeneracy. The different factors affecting the constitution of the ancestor create, as has been shown already, a general loss of nerve tone, which relieves the local nerve systems of control by the central nerve system. These local nerve systems take on a feverish activity in consequence and become themselves exhausted. In proportion, therefore, as the general nervous system has control would the evolution of the teeth and jaws, in their relation to the organ struggle for existence, proceed with regularity.

The influence of food, while beneficial to the organism as a whole, may, as already pointed out, introduce a struggle for existence between the teeth, which would cause local degenerations of these and the jaws. Even in man, employment of the teeth and jaws as a weapon of offense and defense would prevent that degeneracy as a jaw otherwise consequent upon decreased use resultant on a change from vegetable and nut diet to the more easily digested and masticated meat or fish diet. The persistence of prognathism in races as high as those described even when brachycephalic is an indication that the use of the jaw for a weapon interfered with its degeneracy consequent on improved food. It may be admitted that man was a vegetable feeder originally, but, as shown by the atrophic tendency of the vermiform appendix, he early became a user of animal food, albeit not to the extent of the carnivorous mammals in whom the appendix has disappeared. This change, however, early initiated a tendency to variability in the jaws and teeth.

This variability is excellently shown in the following illus-

trations, of four generations of so-called "Anglo-Saxon" Americans of the Knickerbocker type:

Fig. 31. Here is seen a probably Neolithic Hollander type with low receding negroid forehead, small sunken eyes, protruding nose and upper jaw, short upper lip, cheek bones prominent, receding lower jaw.

Fig. 32. This subject was born of the previous type, settled in New York. The change in climate has altered the face considerably. The forehead is higher, broader, and more promi-

Fig. 31.

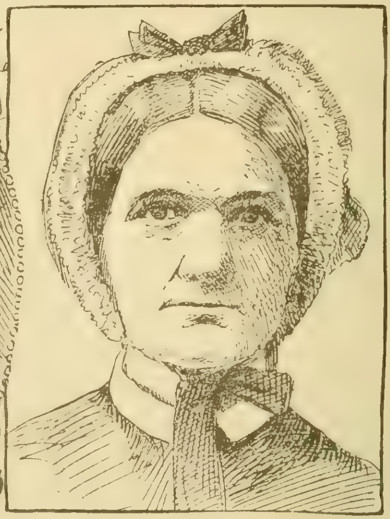

Fig. 32.

nent. The eyes are large and not so deeply set. The cheek bones are not so prominent, nose and upper jaw less prominent, upper lip longer, chin the same.

Fig. 33. Admixture of race types has produced a forehead broad and full, eyes less sunken, recession of cheek bones, nose and upper jaw; upper lip same; lower jaw broader, anterior position same.

Fig. 34. Here the forehead is still broader, more prominent, higher; large, round eyes. There is more recession of the cheek bones. The nose and upper jaw are the same. The face broader, lower jaw broader and anterior position same.

This variability is an expression of the law of economy of growth whereby an organ under the influences of the struggle for existence, degenerates from the ideal type of the organ as an organ for the benefit of the organism as a whole. This variability along local lines of degeneracy has, as De Moor[12] shows, peculiarly taken the line of least resistance in the jaws and teeth.

Fig. 33.

Fig. 34.

The tendency in race admixture (when the new blood is of stocks with large jaws and regular teeth) is to stamp out local influences which tend to produce arrest of development and irregular teeth. By constant race admixture the jaws retain their normal regular shape. The tendency of the child to inherit the small jaws of one and the large teeth of the other or vice versa is a fruitful source of facial and jaw deformity.

12 Evolution by Atrophy.

CHAPTER XIV.

CONSTITUTIONAL DISORDERS.

The influence of constitutional disorders on the development of the skull and face must be viewed from two standpoints. First, from the standpoint of the mother affected during pregnancy, and, second, from the standpoint of the fœtus affected during intra-uterine life, or of the child affected precedent to or during the periods of stress. The influence of constitutional disorders, especially the infections upon the mother, may, as I have pointed out elsewhere, result in the bony maldevelopment shown to occur in animals by Charrin and Gley,[1] and in man by Coolidge. The facial bones, jaws and teeth are peculiarly liable to this. Though the effect of the disease on the parent be but temporary, fœtal development may be checked as to higher tendencies. Thus mothers have borne moral imbeciles, epileptics, lunatics or deformed children after a pregnancy during which they were attacked by contagious disease. The children of subsequent and previous pregnancies were normal.

The children of pregnancies previous to the one complicated by the contagious disease may be healthy, while those of subsequent pregnancies are defective. Any contagious or infectious disease may not only interfere temporarily with the bodily strength, but may produce complete change in the parent's system, extending even to the highest acquirements of man. In some occur changes thus graphically described by Bulwer:[1] "There have been men who, after an illness in which life itself seemed suspended, have arisen as out of a sleep with characters wholly changed. Before, gentle, good and truthful, they now become bitter, malignant and false. To those whom they before loved they evince repugnance and loathing. Sometimes this change is so marked and irrational that their kindred ascribe it to madness. Not the madness which affects them in the ordinary business of life, but that which turns into harshness and discord

[1] Degeneracy, op. Cit.

the moral harmony which results from natures whole and complete."[2]

The nerve centers controlling nutrition, growth, repair, secretion and excretion are often as deeply affected as those checks constituting morality. At the periods of physiologic stress these effects are especially noticeable. Moral insanity, intellectual insanity, unequal mental balance, hysteria, precocious sexuality, unconscious mendacity, mental parasitism (the germ of pauperism), epilepsy, neuroses and all types of nutritive and constitutional defects result. The nutritional defects may appear chiefly in the walls of the blood vessels and lymphatics, as in scurvy mercurial poisoning,[3] etc. While these are most common in the chronic infections and contagions, they often occur in acute, typhoid fever, scarlatina, diphtheria, whooping-cough, etc. Proper blood supply and utilization of waste is thus prevented. Organs cannot perform their function, and are predisposed to disease from disuse and from weakness of the disease-fighting phagocytes and antitoxins. From this results irregularity of organ function, which is hereditarily transmissible. The weakened vessel walls yield to strain, and thus produce local stomach, bowel, liver, gland, and kidney disorders. This organ weakness may alone be transmitted to the offspring. The functions of the great ductless glands (thyroid, thymus, adrenals, pituitary body, bone-marrow, etc.) which secrete principles necessary to the equal balance of nutrition, are perverted. The liver, in the acute but more particularly in the chronic contagions, paralyzed in nerve tone, fails in its functions, nutritive and poison-destroying, as for the same reason the kidneys fail in their power of ejecting hurtful waste. Through this, interaction of perverted nutrition, imperfect poison-destruction and deficient waste ejection result and continue the states of nervous exhaustion after the contagions and infections. Thus nerve exhaustion, with its suspicion, its capricious hopefulness and gaiety, is practically continuous in tuberculosis, syphilis and leprosy.

The influence on bony and dental development of all constitutional diseases in a general way resembles the influence of

[2] "A Strange Story."

[3] Interstitial Gingivitis,

syphilis. This influence is exerted in two ways. First, on the individual, which may affect development of the bones or teeth if it occur during the periods of evolutionary stress. Syphilis contracted during infancy thus affects the development of the teeth. The same is true of all infectious diseases to a greater or lesser extent and is also true of conditions like scurvy and rickets. In a general way also the influence is of the contagious diseases as exerted on the descendant of two types. Firstly, the direct transmission of the disorder, which must be regarded as intra-uterine infection, and, secondly, the transmission from the ancestor to the descendant of sundry pathologic characters having, as E. Fournier[4] remarks, nothing specific per se, but consisting perchance in native inferiorities of constitution, of temperament, of vital resistance, perchance in retardations, arrests (Fig. 35) or imperfections of development, mental, physical or manifested in organic changes; either malformations of organs or monstrosities. The first of these heredities in the case of syphilis has received the title of syphilitic heredity, properly so-called. The second has received several synonymous titles; parasyphilitic heredity, dystrophic heredity, or toxinic heredity. In the last toxins produced by germs or poisons produced by maternal nutritional defects cause the arrests, retardations, imperfections of development seen in the children of otherwise healthy mothers suffering from the infections and contagions or from nutritional disorders or defects just precedent to, or during, the period of pregnancy, or, during the period of lactation. During the periods of stress, moreover, if these toxins or allied substances be generated in the individual organs, they cause the bony and dental arrests, retardations and imperfections of development so frequently noticed after scarlatina, pneumonia, cerebro-spinal meningitis, etc., as well as rickets and allied conditions occurring during infancy and childhood.

The regenerative process in all tissues is below par in constitutional diseases. Hence wounds do not heal as readily in a person the subject of constitutional disease. The development of tissue from an embryonal type to mature tissue is identical with the regenerative process in the healing of wounds. There-

[4] Stigmates Dystrophiques de l'Heredo-Syphilis.

fore, the causes which retard the one process must retard the other. According to Metschnikoff, the energy of the organism is expended in repelling the advances and barring the further progress of the micro-organisms or other causes of constitutional diseases. In consequence of this continuous warfare between the cells and microbes the tissue cells, that are regenerated, do not increase the size of the organs as in normal development.

Fig. 35.

Senile Stress Period of Intra-Uterine Life: four and a half months.

These constitutional diseases cause arrests of development, which may become permanent from the time of the disease. More often the growth of the child is stopped for one or more years, and frequently development will not proceed until the child is taken to another climate. The effect upon the jaws and teeth is very marked, especially in the upper jaw. When arrest of development of the teeth takes place, frequently pits and furrows are found upon the enamel. By these pits and furrows, the

exact year when the arrest of development took place may be determined. Hutchinson's teeth, familiar to physicians, dentists and syphilographers, are striking illustrations of this fact.

The eruptive fevers in children have a tendency to leave the system in a neurotic condition. Children, who before were apparently healthy, after these diseases are sickly and ailing for years, and sometimes they never wholly recover. Such conditions affect the eyes and ears and not infrequently the organs of speech. The eyes remain weak, occasionally the patient becomes nearly or quite blind. The hearing is frequently permanently impaired; occasionally the nerve centers, which preside over the development of the osseous system. There is a general arrest of development of the whole body. Such persons not infrequently remain sickly, neurotic or morally imbecile. While they may regain health, the body ceases to develop normally.

A young girl, now twenty, born of apparently healthy parents, had a severe attack of scarlet fever at the age of seven years. Arrest of development of the upper jaw, and a V-shaped arch developed; she has been near-sighted ever since and now has very weak eyes; stopped growing for three years. She was taken to California and Europe, and has now regained her full growth.

A boy, now fourteen, had pneumonia at the age of four. Arrest of development of the bones of the face is very marked; he has stopped growing and is now very small for his age.

A young lady, now twenty-seven years of age, had scarlet fever at the age of four, with a resultant deaf-mutism. The bones of the face and jaws are undeveloped. She possesses a marked V-shaped arch. The pits and grooves upon her teeth denote the age when she had the disease. She has developed into a very handsome, full-grown woman.

A lady, now forty-five years of age, had scarlet fever at three years. Her eyes became inflamed and she lost her sight for twenty-four years, when they gradually grew better. The bones of the face were arrested in development.

Arrest of development or retardation or imperfection may take place at any period up to the time of full growth. Arrest of development of the jaws, however, as a result of constitutional disease must occur prior to the sixth year to produce dental

deformities. However, this is somewhat modified by the influence of the constitutional disorders on the hypophysis, which may lead to the excessive developments of bony tissue anywhere that occur especially in acromegaly, giantism, etc.

Some arrests of development charged to direct specificity are in reality conditions due to toxinic or nutritional causes. The "old man" appearance of congenital syphilis is in reality an arrest of development of the fœtus at the 4½-month of intrauterine life; the so-called senile period. This arrest of development is produced by other causes than syphilis, whence the senile state in degenerates described by Souques, myself and others.

One expression of degeneracy peculiarly apt to occur around the periods of stress is the condition known as hæmophilia, which is an hereditary constitutional defect evincing itself from a deficient coagulability in a tendency to uncontrollable bleeding, either spontaneous or from slight wounds. This is sometimes associated with sub-oxidization conditions, like arthritis and lipomatosis. This diathesis has long been known. As a rule (to which exceptions exist), the mother of the hæmophile, according to Nasse, is not a "bleeder" herself, but is the daughter of one. The daughters of a hæmophile, though healthy, transmit the diathesis to the male offspring. Hæmophilia generally appears after slight injury during the periods of the first dentition.

The Appleton Swain family, of Reading, Mass., has had "bleeders" for two centuries. Osler has reported instances in the seventh generation. Kolster, who has investigated hæmophilia in women, reports a case in the daughter of a female hæmophiliac. On his analysis of fifty genealogic trees of hæmophiliac families, it is evident that Nasse's law of transmission is not absolute. In fourteen cases the transmission was direct from father to child, and in eleven cases it was direct from mother to infant. Hæmorrhagic symptoms of bleeders are, as Gould points, divisible into external bleedings, either spontaneous or traumatic interstitial bleedings, petechiæ, ecchymoses and joint affections. External bleedings are seldom spontaneous, but generally follow cuts, bruises, scratches. A minor operation on a hæmophile may prove fatal. So slight an operation as draw-

ing a tooth has been followed by the most disastrous consequences. Gum lancing is equally dangerous. Healthy blood placed on the wound has often so coagulated as to check bleeding. This produce is not destitute of dangers as to infection and embolism. Bleeder families are often multiparous, healthy looking and have fine, soft skins. They are, hence, not often suspected of "bleeding" tendencies by the practitioner who sees them for the first time.

CHAPTER XV.

INTELLECTUAL AND MORAL DEFECTS.

There is, as I have elsewhere indicated,[1] a complete transition from the durencephalic (in whom the chondrocranium alone occurs) monster through the microcephalus, the idiot, the imbecile and the feeble-minded, to the mentally normal person. Between the feeble-minded and the normal individual occurs a group whose general characteristics are, as Magnan remarks, a disharmony and lack of equilibrium not only between the intellectual operation properly so-called on the one hand and the emotions and propensities on the other, but even between the intellectual faculties themselves. A degenerate may be a scientist, an able lawyer, a great artist, a poet, a mathematician, a politician, a skilled administrator, yet present from a moral standpoint, profound defects, strange peculiarities and surprising lapses of conduct. As the ethic element (the emotions and propensities) is the basis of determination, it follows that these brilliant faculties are at the service of a bad cause, of the instincts and appetites which, thanks to will defects, lead to very extravagant acts. Sometimes the opposite occurs. Degenerates of irreproachable character may show defects in their intellect, may have feeble memory in certain directions or may be unable to understand figures, music or drawing. In a word an otherwise normal intelligence is lacking as regards certain faculties. The centers of perception are unequally impressionable; are unequally apt to gather together impressions and hence register some impressions only as to leave durable images. Certain relations, certain associations between different centers are perverted or even entirely destroyed. Nearly normal conditions which belong to this category are those sentimentalists, pessimists and neurotics.

Great as is the apparent gap between idiocy and one-sided genius, on the one hand, and between idiocy and crime on the

[1] Degeneracy, op. Cit.

other, this gap is, as already stated, filled by numerous closely interlinked forms dependent on the proportionate removal of checks (which the race has acquired during evolution) on the explosive expressions of egotism. The removal of these checks is dependent on the absence or weakening of brain associating tracts. The idiot capable of only purely vegetative functions who would perish were food not placed far back in his mouth, is one step lower than the normal infant who is, as has been remarked by Harriet Alexander,[2] an egotistic parasite. On slightly increased development, the idiot with the powers of a rather low animal, gains food and satisfies its instinct. These instincts at this stage may manifest themselves in the explosive manner characteristic of the undomesticated and non-social animals. With these instincts may appear others which man has long lost. Thus an idiot girl (who was delivered of an infant when alone) gnawed through the umbilical cord in the manner of animals, effecting separation and preventing hemorrhage. At still a higher stage the imbecile may manifest destructive instincts, may steal without the signs of remorse exhibited by a housebred dog or may kill without recognizing the results of killing. The intellect may be comparatively developed in certain imbeciles in comparison with the ethical defect. For lack of proper associating fibers the imbecile may be unable to acquire those higher associations constituting the secondary ego in the most elevated sense. To this class ultimately belong the instinctive homicides, torturers, sexual criminals and thieves so frequently found among the juvenile offspring of degenerate stock. In them the primary ego is strong and the restraints of the secondary ego, which perceives the rights of others, weakened or completely absent. This class forms the germ of the congenital criminal, whom no discipline can tame, and who is therefore incapable of being taught the dangers of his procedures under the law of the land. Between this class and the paranoiac (or "crank") there is at once a curious likeness and distinction. The lack of proper associating powers prevents the moral imbecile from recognizing any rights of others. The same lack in the paranoiac prevents him from recognizing the

[2] Alienist and Neurologist, 1893-4.

force and rights of other people in opinion. The moral imbecile has lost the greatest acquirement of the race in evolution, that acquirement which fully recognizes the secondary ego in accordance with the sublime precept: "Do unto others as ye would that they should do unto you." Closely akin to that instability of inter-association resulting in loss of proper checks on explosive action in the types just described is the sentimentalism which often covers real hardness, but which charms and allures the mass. This has essentially the psychologic basis of the suspicional tendencies and pessimism with which it is so often associated. Suspicional tendencies arise from states of anxiety resultant on instability of association dependent on lack of associating fibers. Pessimism (so frequently present in the otherwise healthy degenerates) is, as Magalhaes has shown, nervous instability with alternations of irritability and prostration. The subject is supersensitive, impressions call forth intense and prolonged reaction followed by exhaustion. The state is characterized by a general hyperæsthesia, which naturally results in an excess of suffering. From instability and hyperæsthesis results discord between the feelings themselves, between the feelings and the intelligence, between the feelings, the ideas and the will. Discord between the feelings shows itself in a great variety of paradoxes, contradictions and inconsistencies. To the pessimist possession of a desired object does not atone for former privation. Pain or unsatisfied desire is replaced by the pain of ennui. With inability to enjoy what he has are coupled extravagant expectations regarding that which he does not have. He is extremely susceptible both to kindness and contempt. He passes suddenly from violent irritability to languor, from self-confidence and vanity to extreme self abasement. His intense sensitiveness results in the intellectual disorders since this involves a great vivacity of the intuitive imagination which favors the setting up of extravagant ideals lacking in solid representative elements. Hence a gap opens between his ideal and the actual. He can never realize the ideal he pursues and so his feelings are of a somber hue. From this excessive realism results a state of doubt, a certain distrust of all this rational objective knowledge. It assumes another form in extreme subjectivism.

The pessimist is haunted by images of the tiniest religious scruples, suspicions, fears and anxieties resulting in alienation from friends, seclusions, misanthropy. The pessimist is further characterized by an incapacity for prolonged attention by refractory attention and by a feeble will. These result in inaction, quietism, reverie, self-abnegation, abolition of the personality and an annihilation of the will amounting sometimes to poetic or religious ecstasy. Pessimism is frequently associated with a morbid fear of death.

In the tramp, to the restless wandering tendency of the neurasthenic and paranioac are added the parasitic tendencies of the pauper and the suspicional egotism of the less intellectual pessimist.

The one-sided genius is a link between the neurotic and epileptic, the paranoiac, the hysteric and the imbecile. Cases crop up in which all these elements are so mingled as to create a puzzle where they belong. In some cases in accordance with the general law that physiologic atrophy is accompanied by hypertrophy in other directions the intellectual powers other than along certain lines may be remarkably deficient. Moreover, the intellectual power due to healthy atavism is increased seemingly by the degeneracy in certain directions. Without going into the question raised by Lombroso[3] as to genius being an epileptoid neurosis, sufficient evidence exists to show that illy balanced genius often co-exists with defects in a large number of directions. The co-existence of genius with imbecility and even idiocy has been well illustrated by Langdon Down, who cites numerous instances thereof. Defect in genius whether of the imbecile stamp, or otherwise accompanied by deficiency, is not expressed in the genius, but in its deficient accompaniment. Even the mental instability of the highest type of defective genius is close kin to that of the neurotic.

Hysterics, as has been shown by Des Champs, are neurotic women in whom an aggravated sensibility exists. Neurotic women are divisible into three categories, according to the predominance of one of the three centers; cerebral, genital and neuropathic. These types occur pure or intermixed. The gen-

[3] Man of Genius.

eral characteristics are want of equilibrium in sensibility and will power. Mobility of humor occurs in direct relation with facile impressionability to external influences or to internal states. The nerves vibrate to mental states from within or without and all are registered without proper relation. One fact chased by another is forgotten; still another fact produces a momentary re-excitation which takes place of truth whence falsehood becomes instinctive, but the patient protests her good faith if accused of mendacity. This lack of equilibrium leads to decided modification of the mental faculties. Intellectual activity is over-excited, but in diverse degrees and variable ways according to the peculiar tendencies adopted. Absorbed by a preoccupation or controlled by an idea they become indifferent to all else. The ideas are abundant and the idea quickly is the act. Their vivid imagination, coupled with a bright intelligence, gives them a seducing aspect, but their judgment is singularly limited, attenuated, and therefore false. They judge from a non-personal standpoint excellently. They are quick at discovering faults in their nearest relatives, but faults rightly attributed to themselves are repudiated. Their memory is capricious. They forget their faults and their acts under impulse albeit these may be consciously done. The cerebral type, led by the intelligence, has little or no coquetry, except what is the result of intention and temporary. There is an ethical sense, frankness and nobility in her ideas, disinterestedness and tact in her acts. She is capable of friendship. Her taste carries her to male pursuits in which she succeeds. She becomes often what is called a "superior woman," and too often, what is called an "incomprehensible woman." She has little guile. To the sensual type, voluptuousness is the aim of life and the center of her acts and thoughts. She is well endowed with guile and extremely diplomatic, full of finesse, but not very delicate. Her lack of scruple often spoils her tact. She is ruseful, dissimulating and unconsciously mendacious. She despises friendship and needs watching. If circumstances permit she loses her delicacy, reserve and modesty. She is destitute of scruples and her crimes are coolly remorseless. The neuropathic type is one to which the

grasshopper is a burden. Her nerves are always on edge and she is a "heroic" invalid whom trivialities martyrize.

The character of the neurotic, as Kiernan remarks, recalls the observation of Milne-Edwards concerning the monkey character. Levity is one of its salient features and its mobility is extreme. One can get it to shift in an instance from one mood or train of ideas to another. It is now plunged into black melancholia and in a moment may be vastly amused at some object presented to its attention.[4]

Neuroticism in man differs from that in woman only in the fact that anæsthesia, paralysis of emotional origin and conscious convulsions are less common. The male neurotics are subdivisible precisely as the female. Neurotics are often long lived, peculiarly resistant to certain acute and fatal diseases, and frequently retentive of their youthful appearance. This last is to a certain extent evidence of their resistance to the wear and tear of life and advancing old age, and is due to emotional anæsthesia. Recognition of the neurotic tendency often induces the individual to take better care of himself. The youthful appearance is often also largely the result of arrest of facial development at an early age. The face therefore retains the child character throughout life. This class of neurotics (which does not include those afflicted with the more serious nervous disorders, such as epilepsy), may be looked upon as the victims of evolutionary processes, constantly going on in the race and especially under civilized conditions. Neurotics are not met with to any extent among barbarous races, but are numerous in civilized communities where the weak are preserved from early death and then subjected to the struggle for existence. Neurotics are individuals naturally imperfect in some directions, but by the law of economy of growth often superior in others. Their disordered nervous functions and hyperæsthesias are not necessarily indicative of inferiority of general organization compared to their ancestry. They may simply imply a more rapid advance in some one direction in the development of the nervous system than has been kept

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[4] Review of Nervous and Mental Disease, 1891.

up with by the remainder. These defects may sometimes be advance guards in the progress of the development of the race.[5]

Epilepsy, which is chiefly viewed from the standpoint of its "fit," has far more extended mental, moral and other nervous relationship. It is, as Spitzka shows, a morbid state of the brain without a palpable lesion, manifesting itself in explosive activity of an unduly irritable vaso-motor center, leading to complete or partial loss of consciousness which may be preceded or followed by various phenomena expressing the undue preponderance of some and the suspended inhibitory influence of other cerebral districts.

True epilepsy presents an enormous number of sub-groups, exhibiting every variety of deviation from the ideal convulsive form, and the existence of these forms tends to demonstrate the views just expressed. In ordinary petit mal the initial arterial spasm has but to be confined to the surface of the hemispheres leaving the thalamus ganglia undisturbed, and it can readily be understood how the momentary unconsciousness or abolition of cortical function can occur without the patient falling, his automatic ganglia still carrying on their functions. At the same time with the lesser spasm there would be a less extensive sinking of intracranial pressure and less consecutive collateral hyperæmia of the lower centers and therefore no convulsion.[6]

In certain cases, as Meynert has suggested, arterial spasm may fail to affect the entire cortical surface simultaneously, some one trunk may be more previous and as afflux of blood may occur in its special field where certain impressions and motor innervations are stored; the result will then be that the function of the relatively well nourished territory will be exalted. If it be a visual perception territory, sights, colors or luminous spectra will be seen, if it be an olfactory territory, odors will be smelt, if a tactile center, crawling, tingling and cold sensation, if a speech center, cries, phrases and songs may be observed. Thus occur the manifold epileptic aura which is simply an isolated exaggerated limited cortical function. The recurrence

[5] Evolution by Atrophy, DeMoor.

[6] New England Medical Monthly, 1881.

of the aura is readily explicable on the ground of the well-known physiologic law that any nervous process, morbid or normal, having run through certain paths, those paths will be the paths of least resistance for that process to follow in the future. To an extension of the same conditions are due the peculiar convulsive equivalent and post-epileptic mental states.

Behind the moral disorders of idiots, imbeciles, some criminals, some paupers and some prostitutes is the epileptic state. There is no mental or moral disorder which may not occur as a substitute for the "fit."

The moral defects of epilepsy have not unnaturally led to the opinion that crime was an expression of disease or mal-development. Crime being, however, a matter of law rather than ethics, must be dealt with from the standpoint of individual criminals. Tyndall[7] was convinced that the classification given him by a governor of a great British prison, was of truly practical value. Criminals according to this classification were divisible into three types: First, those whom external accident and internal taint had brought within the grasp by the law. They were essentially of sound moral stamina, though wearing the prison garb. Then came those with no strong bias, moral or immoral, plastic to the touch of circumstances which would mold them into either good or evil members of society. Thirdly, came a class, happily not a large one, whom no kindness could conciliate and no discipline tame. They were sent into the world labeled incorrigible. Havelock Ellis,[8] following a similar principle, divides criminals into political criminals who are not necessarily guilty of any anti-social offence. From the Eighteenth Century British statutory standpoint, Washington, Jefferson, Franklin and the Signers of the Declaration of Independence were all criminals of this type. The political criminal of one age or land may therefore be the martyr, saint, or hero, of another. The criminal from passion like the man who resents the dishonor of his daughter, sister or wife, is a modification of the first type described by Tyndall. The instinctive criminal, otherwise the moral imbecile, is the third type of Tyndall.

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[7] Lectures cited by C. K. Mills, Pa. Med. Society Trans., 1882.

[8] The Criminal.

The periodic criminal who suddenly breaks out into anti-social acts at more or less regular intervals is closely allied to the epileptic and the periodic lunatic whether cyclothymiac (circular insanity), maniac, melancholiac, dipsomaniac, nymphomaniac, or other types. Then there is a large class of law made or society made criminals, whose crimes are violations of law, but the reverse of anti-social in nature. Thus during the reign of the normally imbecile paranoiac George III. of England, the husband of a hard-working, honest woman was seized by a press gang and forced to serve in a fleet which sailed with troops for America. He left her destitute with six children, one just born. To avoid starvation for them she stole a bolt of cloth, but troubled by conscience she returned it, was caught, tried and hanged for example. The babe was nursing at her breast just ere the black cap was put on.

Criminals on occasion like this one may be made into habitual criminals by despair and from the evil associations into which the law flings them. The criminals of the political and occasional type are often further removed from degeneracy than the criminal within the law type; the dominant type of the century just closed.

From this fact comes the negative results of so many researches in prisons. These negative results also are due to the observation being made by tyros in medico-anthropometric examination and classification.

Nine decades ago, Grohman,[9] who made positive observations of this kind and was "impressed in criminals, especially in those of defective development by the prominent ears, the shape of the cranium, the projecting cheek bones, the large, lower jaws, the deeply placed eyes, the shifty animal-like gaze." Despine's researches revealed the absence of human checks on the instinctive tendencies in criminals. These started from the doctrine of moral imbecility as elaborated by Rush, Prichard, Brigham, Ray, Galt, C. H. Hughes, and others. Bruce Thomson, testing Despine's results by primitive races and Scotch criminals, found that defective abnormal and anomalous states of the instinctive faculties exist in entire races and in the

[9] Havelock Ellis, Op. Cit.

"moral idiots" that occur in the best races. Criminals are a variety of the human family quite distinct from the law abiding men. A low type of physique indicating a deteriorated character gives a family likeness, due to the fact that they form a community which retrogrades from generation to generation. The low physical condition of juvenile criminals in reformatories, etc., becomes at once obvious if they be compared with healthy, active school children. They are puny, sickly, scrofulous, often deformed with peculiar unnaturally developed heads, sluggish, stupid, liable to fits, mean in figure and defective in vital energy, while at the same time they are irritable, violent and too often quite incorrigible. The adults usually have a singularly stupid and insensate look. The complexion is bad. The outlines of the head are harsh and angular. The boys are ugly in feature and have as a rule repulsive appearances. These diseases of criminals are a proof of their low type and deteriorated conditions. Their deaths are mainly due to tubercular disease and affections of the nervous system. In the greater number crime is hereditary which is, in most cases, associated with bodily defect such as spinal deformities, stammering or other imperfect speech, club-foot, cleft palate, hare-lip, deformed jaws and teeth, deaf-mutism, congenital blindness, paralysis, epilepsy and scrofula.

Elisha Harris, of New York, among 233 convicts found 54 to belong to families in which insanity, epilepsy and other neurosis existed. Eighty-three per cent belong to a criminal pauper or inebriate stock and were therefore hereditarily or congenitally affected. Nearly 76 per cent of their number hence proved habitual criminals. According to Harris pauperism and insanity so revert into each other that insanity in the parent produces crime or pauperism in the offspring or vice versa; crime or pauperism in the parent produces disease or insanity in the offspring. Campagne, Broca, G. Wilson and others about the same time made similar researches.

The American sociologist Samuel Royce, after a careful study of American and European defective classes found that observation of the hereditary nature of pauperism which congenitally reverts into insanity, disease or crime, leaves no doubt

but that pauperism is one of the worst forms of race deterioration and that the paralysis of the human will and its energies is but the result of a fearful dissolution in progress.

The pauper, inebriate, opium user, and cocaine habitue may be all divided as the criminals have already been. In the occasional type whatever defects may be produced on the offspring as regards degeneracy, the stigmata need not necessarily be expected in the individual victim of circumstances. In the periodic and instinctive types such as stigmata will occur with as great frequency as in other cases of these types. The fact is often forgotten that the criminal manifestation of the periodic type as well as the pauper manifestation may be a mere tinge of the underlying degeneracy which would be present and evince itself in some other morbid way did not the pauper, criminal or other tinge make its appearance. There is, however, a pseudo-periodicity produced by pauperism, crime, alcohol and other conditions which turns on the nerve law of periodicity already referred to. In the pseudo-periodic type degenerative conditions while occurring far more frequently than in the occasional types are much less frequent than in the true innate periodic types. The pauper type contains more of the occasional type than the criminal or prostitute, but less than the inebriate.

The tramp contains, however, like the prostitute, more of the degenerative types. In him are found the restless wandering tendencies of the neurasthenic and paranoiac added to the parasitic tendencies of the pauper and the suspicional egotism of the "reasoning maniac." In a general way it may be said that degenerative conditions of skull, jaws and teeth of all the cases of intellectual and moral defect are excellently illustrated by those found in the prostitute. This will be obvious on comparison of those hereinafter given of the prostitutes with the tables regarding other classes to be found in the appendix.

As has been remarked by Mrs. Ballington Booth, of the Salvation Army, a by no means small proportion of the prostitute class are illustrations of the Biblical axiom that "the fathers have eaten sour grapes and the children's teeth are set on edge." Her conclusions are borne out by the results of the

studies of Chaplain Merrick, of the Milbank prison, and by those of Pauline Tarnowsky, Lombroso, Grimaldi, Andronico and myself. Tarnowsky[10] finds that prostitution is crime in women taking the line of least resistance. Prostitutes, like other criminals, are divisible into criminals on occasion (vice, monetary reasons, etc.), accidental criminals, law-made criminals, weak-willed criminals, periodic criminals, born criminals and insane criminals. The proportion of law-made and accidental criminals in the prostitute class is much less than among other criminals. Seduction stands very low in the list of causes. The proportion of the weak willed criminal type is very large. In addition to arriving at similar general conclusions to those of Chaplain Merrick and Mrs. Booth, Tarnowsky[11] points out that the professional prostitute is usually a degenerate being, the subject of an arrest of development, tainted with a morbid heredity and presenting physical and mental stigmata fully in consonance with her imperfect evolution. The physical stigmata due to an imperfect organization are manifested in prostitutes principally by the frequency of skull deformities ($44\frac{1}{3}$ per cent), face deformities ($42\frac{2}{3}$ per cent), ear anomalies (42 per cent), and teeth anomalies (54 per cent). The mental stigmata are more or less marked intellectual feebleness with a notable deficiency of moral sense.

Of 150 prostitutes taken at random from those meeting the necessary requirements (uniformity of race, ability to give their family history, and for years resident of houses of prostitution), Dr. Tarnowsky found signs of physical degeneracy in eighty-seven per cent. The following abnormalities were noted. Deformities of the bony cranium, sugar-loaf heads (oxycephaly), heads flattened at the vertex (platycephaly), narrow heads, compressed at the temples (stenocephaly), oblique crania (plagiocephaly), heads with marked depressions or cavities whether in the region of the bregma or that of the lambda. All these cranial malformations may depend upon different causes. Arrest of development of the bones; premature synostosis of the sutures; pathologic processes during intrauterine life or early

[10] Les Voleuses et Prostituées.

[11] Degeneracy, Op. Cit.

infancy (syphilis, rickets, scrofulous affections, hydrocephalus) meningitis, etc.

Recklinghausen, of Strassburg, claims that in infant crania, premature synostosis of the sutures may produce (according as one or all of the sutures are involved) either dolichocephaly (sagittal suture), trocho- and oxycephaly (generalized synostosis) or plagiocephaly (coronary suture of one side). The girth of the brain, and skull, he states, influence each other reciprocally and form of the cranium, especially the pathologic forms, is ordinarily the result of any concurrent conditions. It may depend as much upon disturbances of the development of the sutural syn-

Fig. A.

Fig. B.

Fig. C.

ostosis or of the bone as upon primordial anomalies in brain development.

Deformed heads in prostitutes present marked development of the external occipital protuberance in one-third of the cases. In an equal number of virtuous women it was found but five times. Among the abnormal skull types presented were three herewith illustrated. In the first the head was flattened at the vertex, the forehead was hydrocephalic, the nose flat and the lobe of the ear as much developed, (Fig. A). In the second, the head was elevated at the vertex and the nose flat, (Fig. B). In the third type the parietal region was asymmetrical, (Fig. C). The anomalies of the face were marked asymmetry, subnasal prognathism and disproportion of different parts. There

was deviation of the nose and deep excavation of its root. The nose, being often strongly flattened, the Gothic palatine vault occurred very frequently. There was frequently complete division of the palate. There were teeth defective, irregular in growth, riding over each other or widely separated. The teeth were often notched and grooved (Hutchinson's and Parrot's teeth). The teeth often encroached outside of the dental arch, the parabola of which was thus rendered irregular. There was atrophy or complete absence of the superior lateral incisor. The anomalies were thus distributed among the 150 examined.

Malformation of the head (oxycephaly, plagiocephaly, etc.) noted in sixty-two women.

Development of the occipital protuberance......	62	Women
Very receding foreheads..........................	18	"
Hydrocephaly	15	"
Face anomalies (sub-nasal prognathism, asymmetry, etc.)	64	"
Gothic palatine vault	38	"
Cleft palate	14	"
Vicious implantation of teeth..................	62	"
Hutchinson's and Parrot's teeth................	19	"
Absence of lateral incisors	10	"
Badly margined ears (Morel)....................	16	"
Defective ears (detached from head, deformed, etc.)	47	"
Anomalies of the extremities....................	8	"

These anomalies were found in the following numbers in the same individual.

In 15 prostitutes, a single anomaly, or one in 10 per cent.
In 34 prostitutes, 2 anomalies at once, or 22.66 per cent.
In 35 prostitutes, 3 anomalies at once, or 23.33 per cent.
In thirty prostitutes, 4 anomalies at once, or 20 per cent.
In 14 prostitutes 5 anomalies at once, or 9.33 per cent.
In 66 prostitutes, 6 anomalies at once, or 6 per cent.
In 4 prostitutes, 7 anomalies at once, or 2.66 per cent.
In 1 prostitute, 8 anomalies at once, or 0.66 per cent.

Eliminating the first fifteen women presenting only one anomaly (who must not therefore be classed as badly organized) and with them one prostitute who showed no physical deviation, the other 134 prostitutes show (82.6 per cent of the

whole) more than one anomaly at the same time. Respectable women (both illiterate and cultured) show an enormous difference. Amongst educated women were found but two per cent of anomalies and among illiterates 14 per cent.

Lombroso, in an examination of 50 prostitutes, found exaggerated lower jaw twenty-six times; plagiocephaly, twenty-three times; asymmetrical noses, eight times; prominent zygomæ, forty times. Grimaldi had from the study of twenty-six prostitutes similar results to those of Tarnowsky.

C. Andronico (who was among the first to describe stigmata of degeneracy in prostitutes) found among 230 the following anomalies. Flat nose, twenty times; handle-shaped ears, thirty-five times; vicious implantation of teeth, ten times; convergent strabismus, two times; facial asymmetry, four times; prognathism, seven times; receding foreheads, thirty-five times.

Some eight years ago I made, in company with Harriet C. B. Alexander and J. G. Kiernan, researches in the Chicago "bridewell." The prostitutes here confined are the least intelligent of the class. The researches are necessarily far from complete, owing to the difficulties under which such researches must be made in case of persons with short-term sentences. They were, however, habitual offenders, some being in the institution from time to time for twenty years.

The number examined was thirty, with the following results:

Race.

Celtic-Irish	13	American	2
Irish-American	5	English-American	1
Scandinavian	3	Latin-Swiss	1
German	1	Negro	2
German-American	1		

These results tell relatively little since the system of "fining" in lieu of imprisonment, of Chicago places only the "obtuse" class under imprisonment. One was seventeen years old, two eighteen years, one nineteen years, five between twenty and twenty-five years, three between twenty-five and thirty, six between thirty and thirty-five, five between thirty-five and forty-five, one was forty-six years old, two were fifty-five, three sixty, and one sixty-five. Neither race nor age data are of special value. There were eighteen blondes, ten brunettes and two

negroes. Four were demonstrably insane, and one was an epileptic.

In sixteen cases the zygomatic process were unequal and very prominent. There were fourteen other asymmetries of the face. Three heads were Mongoloid; one Irish-Celt, one Swiss and one Scandinavian. There were Mongoloid race types in the regions where the first two come. Sixteen were epignathic and eleven sub-nasally prognathic. In one there was arrest of development of the lower jaw and in four arrest development of the bones of the face. The nose was abnormal in six.

There were seventeen brachycephalic and thirteen mesaticephalic skulls. There were no dolichocephalic skulls. There

Fig. A.

Fig. B.

Fig. C.

were three oxycephalic skulls of whom one was a Celt, one a German and one a Scandinavian. There were eighteen dome-type skulls of whom seven were Irish-Celts, five Celtic-Americans, one English Anglo-Saxon, one American Anglo-Saxon, and one German-American. There were four tectocephalic skulls of whom one was an Irish-Celt, one an Anglo-Saxon American and one a Scandinavian. There were three platycephalic skulls of whom two were Celts and one a Scandinavian. There was one plagiocephalic German and a stenocephalic Celt. One skull had a protuberance at the bregma. Twelve occiputs were flattened in four of which there was no tubercle; eighteen had an enormously developed occipital protuberance.

Twenty-nine had defective ears; eleven were of the type shown in Fig. A; nine of the type shown in Fig. B., and nine

of the type C. Normal ears were present in a member of a family which had furnished one mother and two sisters to the institution. Five Celtic-Irish had type A, and three Celtic-Americans, seven Celtic-Irish and one Celtic-American had type B. One Irish-Celt and one American-Celt had type C. One Celt had type A. One German and one German-American had type C. The negroes had type C. One Anglo-Saxon American had type C, and one English Anglo-Saxon had type A. The Scandinavians (all more or less mentally defective) presented all three types. Frigerio (corroborating a fact long ago pointed out by Morel) has said that the ear should be placed in the first rank among the organs affected by degeneracy.

The table XI in the appendix shows the measurements and percentage of jaw deformity.

An allied class belonging to a still blacker phase of biology are the sexual perverts.[12] The congenital form which is associated with the stigmata of degeneracy is an expression of the defective line whence the victim is sprung. Like the prostitute, the sexual pervert may be divided into precisely the same criminals as other criminals.

Between the criminal and the insane is a debatable line occupied by moral imbeciles, reasoning maniacs, etc. In many insane the most demonstrable deviation from the normal consists in disorder of the moral faculties. This is the striking factor of the case since superficially the mind otherwise appears clear and rational by contrast. In these cases, as Krafft-Ebing has shown the most striking features are moral insensibility, lack of moral judgment and ethical ideas. The place of these is usurped by a narrow sense of loss or profit logically apprehended only. Such persons may mechanically know the law of morality. If such laws enter their consciousness they do not, however, experience real appreciation, still less regard for them. The laws to them are cold lifeless statements. The morally defective know not how to draw from them motive for omission or commission. To this "moral color-blindness" the whole moral and governmental order appears as a mere hindrance

[12] Kiernan, Detroit Lancet, 1884.

to egotistic ambition and feeling which necessarily leads to negation of the rights of others and to violation of the same.

These defective individuals are without interest for aught good or beautiful, albeit capable of a sentimentality which is shallow cant. Such persons are repellent by their lack of love for children or relatives and of all social inclinations and by cold-hearted indifference to the weal or woe of those nearest to them. They are without other than egotistic care for questions of social life, sensibility to either the respect or the scorn of others, without control of conscience and without sense of or remorse for evil. Morality they do not understand. Law is nothing more than police regulation. The greatest crimes are regarded as mere transgressions of some arbitrary order. If such persons come to conflict with individuals, then hatred, envy and revenge take the place of coldness and negation and their brutality and indifference to others know no bounds.

These ethically defective persons (where incapable of holding a place in society) are often converted into candidates for the workhouse, jail, or the insane hospital. One or the other of these places they reach after they have been, as children, the terror of parents and teachers through their untruthfulness, laziness and general meanness and in youth the shame of the family and the torment of the community and the officers of the law, by thefts, vagabondage, profligacy and excesses. Finally they are the despair of the insane hospital, the "incorrigibles of the prisons," the veritable burdens of the poorhouse. If intellectual insanity or crime do not claim them, pauperism or criminality is likely to be their destiny. The moral imbecile may, however, keep within the law and achieve business success. His descendants often evince degeneracy in an aggravated form. Many of the "reformers" of various alleged social evils are often of this class. Their morbid egotism takes the direction of cant and sentimentality so common at certain states of evolution as points of least resistance. Like Guiteau, the assassin of President Garfield, they aim at doing a "big thing for humanity and myself," the humanity being concentrated in "my" ideas.

The moral lunatic needs but a slight twist intellectually to

become the paranoiac to whom there is, as Spitzka[13] has pointed out, a permanent undercurrent of perverted mental action, peculiar to the individual running like an unbroken thread through his whole mental life, obscured it may be, for these patients are often able to correct and conceal their insane symptoms, but it nevertheless exists and only requires friction to bring it to the surface. The general intellectual status of these patients, though rarely of a high order, is sufficient to keep the delusion under check for practical purposes of life. While many are what is termed crochety, irritable and depressed, yet the symptom of the typical cases of this disorder is of the fixed delusions. These patients consider themselves either the victim of a plot or as unjustly deprived of certain rights and position, or as narrowly observed by other delusions of persecution are added to the fixed ideas and the patient becomes sad, thoughtful or depressed in consequence or the reverse may occur. Because he is watched and made the subject of audible comments (hallucinatory or delusional), he concludes that he must be a person of some importance. Some great political movement takes place; he throws himself into it, either in a fixed character that he has already constructed for himself, or with the vague idea that he is an influential personage. He seeks interviews with the big men of the day, accepts the common courtesy shown him by those in office as a tribute to his value, is rejected however, and then judges himself to be the victim of jealousy or of rival cabals, makes intemperate and querulous complaints to higher officials, perhaps makes violent attacks upon them and being incarcerated in jail or asylum looks upon this as the end of a long series of persecutions which have broken the power of a skilled diplomatist, a capable military commander, a prince of the blood, an agent of a camarilla, a paramour of some exalted personage or perchance the Messiah Himself. All through this train of ideas there runs a chain of logic and inference in which there is no gap. If the inference of the patient were based on correctly observed facts and properly correlated with his actual surroundings his conclusions would be perfectly correct. For years and years many such

[13] Spitzka, St. Louis Clinical Record, 1879-80.

patients exhibit a single delusive idea as the only prominent symptom. There is hereditary taint in most of these subjects who are strange in disposition from infancy. As children they frequently shun society and indulge in day-dreams. Their bodily growth is normal, but even trifling disease takes on a cerebral tinge. They may show talent in special directions, but their intelligence rarely passes out of the puerile stage. They often brood over a feminine ideal, a girl who has never encouraged them, and whom they persecute with absurd plans of marriage.

Connecting the paranoiac with the moral imbecile are the co-called "reasoning maniacs" in whom the intellectual power is less than either that of the moral imbecile or of the paranoiac, twisted though the intellect of the latter be. Loquacious or unusually taciturn, heedless or morbidly cautious, dreamers, wearisome to all brought in contact with them, capricious and unmitigated liars, their qualities are often in a certain manner brilliant, but are entirely without solidity or depth. Sharpness and cunning are not often wanting, especially for little things and insignificant and, quick comprehension, they readily appropriate the ideas of others, developing or transforming them and giving them the stamp of their own individuality. But the creative force is not there and they rarely possess enough mental vigor to get their own living. Passing without the slightest transition from one extreme to another they felicitate themselves to-day on an event which they sneered at the night before. In the course of a single second they change their opinion of persons and things; novelty captivates and wearies them almost at the same time. They sell for insignificant sums things they have just bought, in order to buy others which, in their turn, will be subject to like treatment, and, strange to say, before possessing these objects they covet them with a degree of ardor only equaled by the eagerness they exhibit to get rid of them as soon as they become their own. To see, to desire and to become indifferent to these stages which follow each other with astonishing rapidity.

The intense egotism of these persons makes them, as W. A. Hammond has shown, utterly regardless of the feelings and rights of others. Everybody and everything must give way to

them. Their comfort and convenience are to be secured, though everyone else is made uncomfortable and unhappy; and sometimes they display positive cruelty in their treatment of persons who come in contact with them. This tendency is especially seen in their relations with the lower animals.

Another manifestation of their intense egotism is their entire lack of appreciation of kindness done them or benefits of which they have been the recipients. They look upon these as so many rights to which they are justly entitled and which in the bestowal are more serviceable to the giver than the receiver. They are hence ungrateful and abusive to those who have served them, insolent, arrogant and shamelessly hardened in their conduct toward them. At the same time, if advantages are yet to be gained, they are sycophantic to nauseousness in their deportment toward those from whom the favors are to come. The egotism of these people is unmarred by the trace of modesty in obtruding themselves and their alleged good qualities upon the public at every opportunity. They boast of their genius, their righteousness, their goodness of heart, their high sense of honor, their learning, and other qualities and acquirements, and this when they are perfectly aware they are common-place, irreligious, cruel and vindictive, utterly devoid of every chivalrous feeling and saturated with ignorance. They know that in their railings they are attempting to impose upon those whom they address and subsequently will even brag of their success.

It is no uncommon thing for the reasoning maniac still influenced by his supreme egotism and desire for notoriety to attempt the part of reformer. Generally he selects a practice or custom in which there is really no abuse. His energy and the logical manner in which he presents his views, based as they often are on cases and statistics, impose on many people who eagerly adopt him as a genuine overthrower of a vicious or degrading measure. Even when his hypocrisy and falsehood are exposed he continues his attempts at imposition and when the strong arm of the law is laid upon him he prates of the ingratitude of those he has been endeavoring to assist and of the unselfishness and purity of his own motives.

CHAPTER XVI.

INTER-OPERATIONS OF CAUSES AND PREDISPOSITIONS.

From the previous chapters, it will be seen that forces tending to change in an existing organism, act in various ways as part of the environment of the individual, and through its influence on him produce changes in the complex union of checks, balances, forces and material bases which constitute the human organism as inherited. Of necessity any change in this complex unity being unusual must be abnormal so far as the organism existing prior to the change is concerned. The question whether such abnormality be of benefit or injury is another matter.

As Virchow[1] remarked seven years ago: Transformation, a metaplasia, a change from one species into another, whether in individual animals or plants or individuals or their tissues, cannot take place without anomaly; for if no anomaly appear this new departure is impossible. The physiologic norm hitherto subsisting is changed, and this change cannot well be called anything but an anomaly. In former days an anomaly was called pathos and in this sense every departure from the norm is a pathologic event. If such pathologic event be ascertained, this forces investigation as to what pathos was the special cause of it. This cause may be, for example, an external force or a chemical substance or a physical agent producing in the normal condition of the body a change, an anomaly (pathos). This can become hereditary under some circumstances and then may become a foundation for certain light hereditary characteristics propogated in a family. In themselves these belong to pathology, even though they produce no injury. Pathologic does not mean harmful, nor does it indicate disease. Disease in Greek is nosos and it is nosology that is concerned with disease. The pathologic under some circumstances may be of advantage to its inheritor.

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[1] Correspondenz-blatt v. Deutsch. Gesellschaft f. Anth., 1894.

From this standpoint it is obvious that the fact whether a given change in the organism shall prove a defect or not is determined by the conditions of periods of stress during intra and extra-uterine life. According to general observations made by Weismann and others any condition affecting the individual must in some way affect the organism as a whole in order to survive these periods of stress.

In dealing with the origin of any defect or gain in the animal organism, several factors must be taken into account, independently of the simple element of heredity. Heredity, moreover, is not the uncomplicated agent which is usually regarded as producing certain effects. In dealing with heredity the influence of the inter-uterine stress on the fœtus must be determined. Unusual strain of any kind upon the mother during gestation may unfavorably effect the fœtus. The healthier the ancestry the less liable the mother would be to ill effect from such strain. On the other hand unusually favorable conditions during gestation may correct defects observable at previous pregnancies. Periods of stress are constituted by the different periods of embryonic development as well as by those extra-uterine. Even sex is determined by conditions of stress after a certain period. Poor maternal nutrition will determine an excess of males, while good will determine an excess of females. Arrests at certain periods of intra-uterine life will produce prematurely senile states; since, as already stated, there is a period in intra-uterine life during which the fœtus wavers between the senile appearance of adult anthropoid apes and that of mankind in youth. This intra-uterine stress may be an expression of the general nervous exhaustion of the mother which first affecting checking influences of the central nervous system finally leads to unchecked excessive nervous action of the part of the local nervous systems of the organs leading secondarily to exhaustion of these. In consequence the mother is unable either to manufacture proper elements of nutrition or to excrete waste material. The fœtus thereby, starved and poisoned, fails to pass through the periods of stress in a complete well-balanced manner. The stress in these periods is strongest on those structures which are transitory and variable in type. This influence may further-

more be exerted on the fœtus through stress, mental or otherwise, of the mother. The human fœtus exhibits, as elsewhere shown, very decided reaction to sensory impressions on the mother.

At every one of these periods, the forces which determine the variations of the individual from the race and those which tend to preserve the race type are in constant conflict. Conditions affecting nutrition of the ovum prior to fecundation (as derived from the mother) and conditions affecting the fecundation of the ovum (as derived from the father), as well as those derived from both father and mother after fecundation, will determine whether or not the fœtus shall pass through the complete embryologic evolution determined by the race type and, whether or not individual variation present in the parents shall be transmitted successfully through these periods of stress.

While all of the factors enumerated, enter into the cause of jaw degeneration, one of the great factors is the extraction of the temporary and permanent teeth. In no country is this pernicious habit so marked as abroad. Constant extraction of the teeth produce variations (arrest of development) which are transmitted from one generation to another. In the evolution of the jaws, nothing could be easier accomplished than this. One period of stress is marked by eruption of the temporary and the next period of stress by the eruption of the second set. The first permanent molar is the first tooth to erupt in the permanent set. It is situated in the center of the jaw. Permanent teeth erupt anterior and posterior to this tooth. This tooth, because it is larger, requires more room. The first molar is the first tooth to decay. As soon as it aches it is removed. When the other permanent teeth erupt they move forward and fill the space made vacant by the lost first molar. Since, therefore, the jaw expands and grows only for the purpose of containing the teeth, if they be not present the jaw ceases to develop. What is true of the first molar is also true of the other teeth. In many countries one tooth after another is sacrificed as soon as it begins to ache. Not infrequently whole sets of teeth are removed in young life before the jaws have fully developed. The habit of early extraction of the

temporary and permanent teeth from one generation to another causes arrest of development in two ways. First, through the inheritance of acquired defects; second, by natural selection. Since the jaws and teeth are so unstable in their development they are easily affected.

The influence of the complex sociologic state civilization, while not having the malign influence ascribed to it, has, by its economy as regards food production and preparation, lessened markedly the functions of the jaws and teeth. Food no longer needs the grinding and tearing required from primitive man or even types as high as the "pile dwellers," whose food is still to be found even to coarse breads and cakes. Under the law of economy of growth, lessened muscular action leads to lessened blood supply. Lessened blood supply produces conditions in the offspring tending to under nutrition of certain parts for the benefit of the body as a whole and to diminish in size of unused parts. As the jaws, alveolar process and teeth are comparatively unstable in all mammals, these of necessity would be peculiarly affected by disuse. A very similar evolution is occurring in the dog in whom domestication plays the part of civilization and who from a carnivore has become an omnivore. In the mongrel dog, race admixture and other factors producing change in man are to be found. In him, peculiarly, domestication would play the part of civilization. In him jaw and tooth irregularities ascribed to other causes occur. Facility for producing food under domestication has played a part. Disuse of the jaw as a weapon by man has done its share in the changes comparatively early in development. To a certain extent this last change is still going on in the dog. In cases predisposed to advance in evolution, irregularities of beneficial type would occur with great facility. In cases predisposed in the opposite direction changes would result of opposite effect.

As (Table XXXIII) shows the irregularities of the jaws and teeth increase proportionately westward from Greece to the British Isles, the rate in the British Isles being greatest. Greece, however, no longer contains the race which so long dominated the world intellectually. The people are a mixed Slavo-Mon-

goloid race who speak Greek. Furthermore as the correctional charitable and hospital arrangements are primitive the defective classes are not accumulated. Under such conditions a certain seeming decrease in stigmata of degeneracy must result. This, however, would extend more to deeper stigmata than to those of the jaws and teeth. As tables show degenerate jaws and teeth are commonest next to the English speaking people among the Scandinavian speaking. As both have passed through very similar phases of race evolution and both contain at bottom the same race elements, this was to have been expected. The general result of this table shows, as I have pointed out some years ago, that the struggle for existence between the organs, dependent on race evolution and race admixture, has resulted in the higher races in the triumph of the brain and skull at the expense of the face, hence, the higher the intellectuality the greater the tendency to local degeneracy of the face, jaws and teeth.

CHAPTER XVII.

DEVELOPMENTAL NEUROSES OF THE FACE.

To the great anatomist, Camper, belongs the credit of studying the human face from the scientific standpoint. This great anatomist gave his name to the facial angle which, even up to the present day, serves as a standard by which to judge the rank of the human face in comparison with the lower forms of animals. In one of his works he gives (Fig. 36) "physical observation on the difference of the feature of the face considered in profile, as the heads of apes, orang-outangs, of negroes and other peoples, tracing up to antique heads." "You will be astonished," he says, "to find among my first plates two heads of apes, then of a negro and then one of a camel."

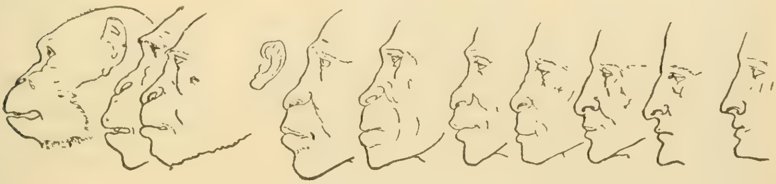

Fig. 36.

Showing the gradual retreat of the jaws in passing from the lower to higher types of face. (Rimmer. Art Anatomy, London, 1884.)

The facial angle of Camper, Cuvier, Cloquets, Jacquarts, the Munich-Frankfort Angle and that of Topinard involve merely the bones of the face, not the inferior maxilla. Most authors dealing with prognathism and orthognathism refer merely to the skull including the superior maxilla. Medical specialists must, however, include the inferior maxilla in the outline in order to show what may or may not be required in improving the jaws and teeth. In studies of the etiology of irregularities of the jaws and teeth, I have simply extended the facial line downwards below the lower jaw, Fig. 37. An imaginary perpendicular line dropped from the superciliary ridge below the lower jaw will decide whether the jaws be prognathous or orthognathous.

During a trip to Europe in 1897, observations were made in both the British Isles and the Continent as to the facial angle. In most countries casual examination was made, but where marked deformities presented themselves more careful observations were conducted. The soldiers, police and cabmen, as a rule, as well as citizens were observed. In Stockholm, on examination of 5,000 people, the following results were obtained, two per cent outside the perpendicular, 14.70 per cent on the line, and 83.30 inside the line. In London, examination of the faces of 10,000 passers-by revealed 4.13 outside the line, 12.87 on the line, and 83.00 inside of the line. In an examination of 3,000 English school children (about ten years of age), 93 per cent possessed jaws inside of the perpendicular line. Prog-

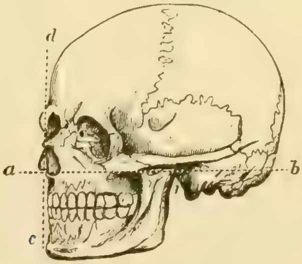

Fig. 37.

nathism elsewhere in Europe furnishes an offset sufficient to interfere with the production of marked irregularities.

In comparison with these results are those obtained in Baltimore under the supervision of B. Holly Smith, by William C. Palmer; in Chicago Robert Keith, under my own supervision. Those made in Baltimore showed 8 per cent outside the line; 36.5 on the line, and 55.5 inside the line. Those in Chicago were 4.6 outside the line; 14.6 on the line, and 80.7 inside of the line.

The rapidity of evolution of the facial angle is shown in the faces of American negroes. On examination of 357 by William Ernest Walker in New Orleans, protrusion was found in 97.5; on the line 2.5 per cent. On examination by Arthur R. Dray, of 686 in Philadelphia, 83.57 per cent were found to present protrusion, and 15.95 on the line; 1.13 recession. On examination

of 1,085 in Chicago, 51.06 presented protrusion; 31.08 per cent on the line and 16.6 recession. Examination by Eugene F. O'Neill, of negroes in Boston showed that of 1,000, 454 or 45.4 per cent were protrusion, 395 or 39.5 per cent on the line and 151 or 15.1 per cent receding. O'Neill says, "many of the faces classed as protruding have a marked protrusion of both jaws, but have the symphysis well back of the vertical plane. In fully one-half of the cases enumerated as protruding, the protrusion is comparatively slight and a smaller number has the typically protruding angle which is shown in the diagram.

Evolution of the jaws in their recession is hence more rapid than the teeth and alveolar process. The teeth do not grow small in proportion to the jaws, wherefore they retain their contour. Northern and older negro families from race admixture have less protrusion and more recession than the Southern negro. Ward has shown that absolute size of the lower jaw is greater in savages: "Of nine aborigines, including seven North American Indians, one African and one American negro, six Malays and five Australians, all with beautifully perfect teeth, the mean weight of the jaw was 102.4 grams. Of eighteen white males the mean weight of the jaw was only 83.4 grams. Yet the weight of the skull was nearly alike in both classes, being 690.9 grams for the aborigines as against 680.5 for the whites. The weight of the lower jaw compared with that of the cranium, or the Cranio-Mandibular Index, as I have termed it, is 15.6 for aboriginal men as against 12.16 for white men. It is 46.2 for anthropoid apes, our nearest living relatives among mammals.

Does not this prove a progressive degeneracy in the masticatory apparatus of civilized man?"[1]

Examination of the heads of eighteen negroes, taken at random, revealed that five had a cephalic index below seventy, six between seventy and eighty, and seven above eighty. These results tend to show that mesocephalic skull types are increasing in numbers among American negroes and that the jaws are gradually shortening. Dolichocephaly is decreasing. Upon

[1] A Cranio-Mandibular Index. Proceedings of the Association of American Anatomists, 1897.

examination of about two thousand Chicago negroes, I was able to find but six cases of dolichocephaly. Even allowing for slight admixture of brachycephaly from the negro races themselves, it is obvious that changes in climate and admixture with the Indian and Caucasic races in America have completely changed the shape of the head as well as the physique of the negro.

The persistent prognathism of the negro is due in a great measure to excessive development of the inferior maxilla. The rami and body of the lower jaw, also the muscles of mastication, are very large and massive compared with those of the white; upon the other hand the superior maxilla is smaller and more delicate. The constant force of the larger lower jaw upon the

Fig. 38.

upper, causes the alveolar process to be carried forward and upward, thus producing prognathism. American negroes to-day (especially those living in the Northern States) possess jaws not unlike those of the Caucasic races. The zygomatic arches are smaller, the muscles less dense and rigid, the lower jaw massive and orthognathism in lieu of prognathism occurs to a certain extent. This is brought about by the arrest of development of the muscles and body of the lower jaw, due to change of climate and of soil and race admixture.

Since Camper's time scientists have been studying the peculiar forms and shapes of the face more extended.

As I have pointed out elsewhere, the degeneracies imply deficiencies in constitution not only in mental, moral, but also

in neurosal and other directions. These deficiencies, as has been shown in the discussion of neuroticism, are often expressions of imperfect advance evincing itself in the unequal balance between hypertrophy, excessive development, statu quo and atrophy. This is especially illustrated in the following cases showing protrusion and arrest of development of the face and jaws. In the first case the figure given is a correct outline of the patient described albeit the figure is taken from Tarnowsky.

Case I, Fig. 38. The patient is a school teacher, thirty-seven years of age, of nervous temperament, bright, and well edu-

Fig. 39.

cated. Father is a periodical drunkard. The paternal grandmother died of consumption. One of the paternal cousins committed suicide, and another became insane. A sister of this cousin hanged herself. The grandmother on the mother's side became insane and a grandaunt committed suicide. The patient was born in the East, but came West on account of a tendency to consumption. The forehead is very prominent, with a marked depression at the bridge of the nose. The nose is undeveloped and has the appearance of falling into the face. Hypertrophy of the mucous membrane and bones of the nose require her to breathe through the mouth. The chest is undeveloped. She

is round-shouldered. The jaws and chin are fairly well developed. The alveolar process, although small for the body, has normal dental arches. Width outside first permanent molar, 2; outside second bicuspid, 1.90; width of vault, 1.60; height of vault, .62. Third molar not present and teeth small. Ordinary causes of deformity are hence absent.

Case 2, Fig. 39, is a twenty-three year old man, whose mother was epileptic and died in the status epilepticus. The father died of locomotor ataxia. The lower jaw seems prognathous. The face from the upper border of the lower teeth

Fig. 40.

to the superciliary ridge is markedly concave. The superior maxillary bones as well as the zygomæ are arrested in their development. The eyes are quite deeply set in the head. Forehead narrow and quite prominent. There is total collapse of the walls of the nose, difficulty in breathing, hypertrophy of the turbinated bones and mucous membrane, adenoid growth and mouth-breathing. In this case the lower jaw is not excessively developed since the teeth, which are not large, just fill the space, while the incisors do not protrude and the third molars are in place. The upper jaw, however, is greatly arrested in

development. The third molars are not present. They could not erupt if they were there for want of space. The left first bicuspid has been extracted allowing spaces to occur between the incisors. In order that the teeth may all come into position, the anterior alveolar process has been pushed forward .60 of an inch. If the bones of the face had developed, the lower jaw would have appeared to a better advantage. There is arrest of development of the superior maxillæ, zygomæ and nasal bones with a normal lower jaw. A marked ridge extends the entire length of the vault at the suture. The distance outside

Fig. 41.

of first molar is 2; outside of second bicuspid, 1.75; width of vault betwen second bicuspid, 1; height of vault, .62. The chest walls are very contracted, the shoulders considerably stooped and the chest expansion very slight.

Case 3. Fig. 40. A young man twenty years of age is markedly neurotic. Bookkeeper, but is above the average in intellect. The appearance of the face and jaws are about the same as Fig. 39, with this exception, that the zygomæ are a little more developed. Width outside first permanent molars, 2; outside second bicuspids, 1.72; between second bicuspid, 1.02; height of vault, .59. There is total collapse of the nasal openings, causing him

to breathe through the mouth since he was four years of age; the two sides of the left nostril approximate, while the turbinated bones upon the right side owing to hypertrophy fill the space. A thickening of the mucous membrane throughout the anterior and posterior nares is also observed. This picture was taken two years after the contour of the teeth had been restored; therefore, the upper lip is more pronounced than in Fig. 39. There is, however, a marked concavity of the face between the zygomæ and the upper jaw; the upper lip was depressed as in Fig. 39 before the operation. The chest is very contracted, with

Fig. 42.

very little or no expansion on inhalation. The father has well formed jaws. The mother has marked arrest of development of the upper jaw.

Case 4, Fig. 41, is a married stenographer of excellent habits and good principle, steady and a hard worker. When a small child he was a chubby, fat boy. His father and uncle possess this arrest of development. This gentleman has two sisters and a brother; one of the sisters has the deformity and a brother slightly. The cheek bones are prominent, there is arrest of development of the superior maxillary bones, a well formed and regular alveolar process and dental arch, fine teeth and full normal

lower jaw. Width outside first permanent molar, 2.25; outside second bicuspid, 1.90; width of vault, 1.26; height of vault, .52. With such a history no one could dispute that this deformity was a clear case of direct heredity. The chest is a little broader than the other two, but there is the same weakness of voice.

Case 5, Fig. 42. This patient was above the average in intellect. Father, mother, brother and sisters all living; no untoward family history. He was a marked neurotic; a fair dentist, but liked medicine better and would have made a good practitioner. He was a good musician; could play several instruments but pre-

Fig. 43.

ferred the cornet. Arrest of development of the upper jaw occurred at or about the sixth year. As the teeth were crowded, with considerable protrusion of the anterior teeth and alveolar process, there was a pronounced semi-saddle-shaped jaw. Was strictly temperate. Died at the age of twenty-six of paretic dementia (of the acquired type). Width outside first molar, 2.03; outside second bicuspid, 1.90; inside, 1.60; height of vault, .75.

Case 6, Fig. 43. Aged forty-one years; married. Born in England of English parents. Father, sailor, died of peritonitis;

mother, heart rheumatism. He came to America fifteen years ago. He is in the harness business and of excellent habits. The patient is a neurotic. The bones of the face are arrested in their development. The line drawn from the bridge of the nose to a point opposite second molar produces a marked depression. There is a marked arrest of the lower jaw. The anterior surface of the lower centrals occlude at the first bicuspid; this gives the appearance of no chin. All the teeth are present in the upper jaw, the width of which is 1.75 outside first permanent molar; it is also a saddle-shaped arch. In order that the jaws may accommodate all the teeth, they have pushed the alveolar process and jaw bones forward. This man has always been a mouth breather.

Fig. 44.

The mouth, therefore, has always been open; as a result the teeth and alveolar process have grown downward. Although the lips are long enough, he cannot close them, owing to the excessive development of the alveolar process. The alveolar process and teeth of the lower jaw are normal in development. The height of vault is .82 (this is an unusually high vault). The alveolar process is large and thin. The excessive development of the alveolar process nicely illustrates how high vaults are produced. The cheek bones are also arrested, but not to the extent of some. The eyes are deeply set; the superciliary ridges very prominent. The nose is very long and thin; the sides of the nose approximate and there is a marked thickening of the mucous membrane; nose breathing is impossible; the chest is

contracted and the mouth is continually open. The head is submicrocephalic; the forehead low; the posterior part of the head is very prominent; the ears are large.

Case 7, Fig. 44. Twenty-nine years of age. Her father is now suffering from paralysis. The patient is a neurotic. She is a fine musician and artist and a brilliant conversationalist. Jaw bones proper are well developed. The rami are excessively developed, but the teeth and alveolar process are undeveloped. There is very little enamel upon the teeth, and what remains can be scraped off like horn. The crowns of the teeth are worn

Fig. 45.

away one-half their length. Width of the jaw outside first molar, 2.25; outside second bicuspid, 2; width of vault, 1.50; height of vault, .50. She is unable to bring the teeth together and therefore cannot masticate her food. To compensate for this she does her chewing with her tongue and the roof of her mouth, on account of which her tongue has become hypertrophied to such an extent that the jaw has been widened by the lateral pressure upon the teeth. With an effort she can bring her jaws together, which makes her pout and the chin protrude, making her resemble an old woman. In order to meet this deficiency crowns

were placed upon all her teeth, which had the effect of bringing her jaws at rest in the proper positon.

Case 8, Fig. 45. This patient is eight years of age. His father and mother are Scotch and are cousins. He has arrested hydrocephalus with resultant macrocephalic head. He is about the average in intellect. The first permanent molars have erupted and the central incisors are just coming through. It is early yet to decide just what deformity will be produced, because the permanent teeth are not far enough advanced. A saddle or V-shaped is sure to follow, because there is not room for the

Fig. 46.

cuspids and bicuspids to erupt. Arrest of development of the lower jaw is quite noticeable at this early age. There is considerable hypertrophy of the superior alveolar process now. Width outside first molar, 2; height of vault, .50.

Case 9, Fig. 46. This girl is a fourteen-year-old neurotic. Father and mother are living. The upper jaw and face are very much undeveloped. The dental arch was V-shaped and the teeth very irregular. This picture was taken after the teeth were regulated. The upper dental arch was spread .62. The face, therefore, is fuller in every direction and appears at a better

advantage than it would otherwise. She is very bright and a fine reader. The jaw became arrested at the sixth year. Width outside first permanent molar, 1.75; outside second bicuspid, 1.50; width of vault, .84; height of vault, .50. Before treatment the face was very thin and contracted at the alæ of the nose, not unlike Figs. 55, 56, 57. She is a mouth-breather. There is marked thickening of the mucous membrane and hypertrophy of the turbinated bones. While the chest is very much contracted, it is now filling out. She has a husky voice and a very old face. This case shows how much a face can be improved by treatment.

Fig. 47.

Case 10, Fig. 47. Seven years of age. Father and mother living. No history obtainable; both have well-developed jaws. This boy has always been a mouth-breather. He has been sick most of his life. He has so little vitality that it was with difficulty he has been raised to this period of his life and is still delicate. There is septum deflection, mucous membrane and turbinated bone hypertrophy. The mouth has been kept open to such an extent that occlusion has not taken place. The rami are short; the result of this is, nature has caused an excessive

development of the anterior alveolar process. Width outside first molar, 2; outside second temporary molar, 1.75; width of vault, 1; height of vault, 36.

Case 11, Fig. 48. Age thirteen years. Father and mother living; father a paranoiac. He has an excessively developed forehead and well developed jaw. The boy borders on imbecility. The face looks like that of a man thirty-five or forty years of age. This is a result of arrest of development at the "senile" (four and one-half month) period of intra-uterine life. The whole

Fig. 48.

body is arrested in its development. His legs are short and he walks like a man of seventy. His joints are large, while the bones are very small, showing impoverished blood. There is a marked arrest of development between the supercilary ridges and the zygomæ and also the lower jaw. This gives an apparent protrusion to the nose and upper jaw. The eyes and their sockets are also arrested. He is obliged to wear glasses on account of astigmatism. The bones of the nose are well developed and there is plenty of breathing space. He has a growth of fine, white hair all over his face. The ears are undeveloped. The hearing is affected. Width outside first permanent molar, 1.84;

outside second bicuspid, 1.75; width of vault between second bicuspids, .84; height of vault, .50.

Case 12, Fig. 49. This patient, now sixteen years of age, came to have a deformity of the mouth corrected, four years ago. Her mother is a neurotic. Her father, although a large, fleshy man, has small jaws. Marked arrest of development of the bones of the face has taken place. She possesses a very thin nose, deflection to the left of the septum; enlarged right inferior turbinated bones and hypertrophied mucous membrane. She is a mouth-breather like Fig. 48, the mouth being kept open. The anterior

Fig. 49.

alveolar process has developed downward, causing the teeth to protrude. Width outside of first molar, 1.95; outside second bicuspid, 1.65; width of vault, 1; height of vault, .47.

Case 13, Fig. 50. There is here excessive development of the bones of the face. This lady, thirty-two years of age, married, has one child. Father and mother living and in perfect health. She is healthy in every respect and above the average in intellect. Bones of the face are normal, except zygomæ, which are excessively developed.

Case 14, Fig. 51. This patient has a weak physical make-up;

has very contracted chest and stoops. Marked arrest of bones of the face, long slender nose, the outer walls coming in contact with the inner, and therefore a mouth-breather. There is slightly excessive development of the lower jaw. He was supposed to be in consumption and was ordered West. The change of climate and out-door exercise have completely restored him to health.

Case 15, Fig. 52. This gentleman is a medical student, possesses about the same history as Case 14. He, however, has more marked deformity. There is a great arrest of development

Fig. 50.

of the bones of the face and a more marked protrusion of the chin; this, however, does not show owing to the beard.

On comparison of these cases there is very little difference in the width of the upper jaw in the first five cases. Three are 2, one 2.03 and one 2.25. Fig. 38 shows arrest of development at the bridge of the nose. Fig. 39 shows arrest of development of the bones of the face extending from the supra-orbital ridge, including the eyes, zygomæ and superior maxillæ, presenting a concavity of the face as far down as the superior border of the inferior teeth. Fig. 40 is precisely like Fig. 39 with the excep-

tion that the zygomæ are still more developed. Fig. 41 is exactly like the last two, with the exception that the zygomæ are still further developed. In Fig. 42 the features are still more normal, but arrest of development is not noticed at the alæ of the nose. Fig. 43 not only shows arrest of development of the bones of the face, but also marked arrest of the inferior maxilla. The apparent prognathism is the same in all except Fig. 44. This is not excessive development of the lower jaw, but a normal development. The lower jaw develops independently of the bones

Fig. 51.

of the head, and, owing to its mobility, usually develops normally. The apparent prognathism is due to arrest of the upper jaw.

In a large number of cases, however, the face is normal, but the undeveloped lower jaw is present. Again, the bones of the face are normally developed upon one side and arrested upon the other. In these cases all the conditions presented in the chapter on the development of the bones of the face are readily seen.

Comparing these faces and their deformities with those of the degenerate classes the deformities of one do not differ from the other. The make-up of the contour of the head, face, jaws

and ears of degenerates differ from the others only under dental observation.

The question naturally arises, at this point, as to how frequently stigmata occur with people in the ordinary walks of life. Repeated examinations in street and steam cars, medical and dental colleges, halls and practice in and about Chicago have given the following results: In practice, 68 per cent; in halls, cars, etc., from 45 to 65 per cent; in a billiard hall, out of 128 persons, either playing or looking on, 72 to 87 per cent of deformities of the face and jaws. In medical and dental colleges,

Fig. 52.

where students come from the country and different parts of the United States, the percentage will fall as low as 45 per cent, while the congregation of city people, who necessarily include large numbers of degenerates from rural regions, the per cent of deformities will range from 55 to 65. It would not be fair to take the percentage of my patients into consideration, because my practice is made up largely of the treatment of irregularities of the teeth. In analyzing the large percentage found in dental examinations, the fact should be remembered that irregularities of the jaws and teeth come under observation in large numbers

for special treatment. It would, however, be safe to say that from 55 to 60 per cent possessed these deformities. Taking the defective classes, which include numbers of acquired cases not necessarily of defective birth or heredity, as a whole, as found in asylums, the difference in percentage of deformities between them and society at large is not striking. If, however, congenital cases, habitual criminals, drunkards, prostitutes, paupers, etc., be considered the percentage is from 85 to 95 per cent.

In cases just cited are to be noticed arrested development of the orbit. As in other parts of the face, the checking of the development of dermal bones plays a part here. The potentialities of the infant are not on this account fulfilled. As I have elsewhere shown when the typical infant begins to develop, the cerebral part of the skull predominates over the facial more than in the adult, the superciliary ridges are not developed, the alveolar borders are not prominent, nor are the cheek-bones, the nose is without a bridge and the cartilages are flat and generally short, the eyes are larger. In this last particular the human infant resembles the lemurs and therein retains an embryonic tendency. In some degenerates this tendency remains unchecked. The result is unusually large orbits. In other instances the orbit of the human fœtus passes through this lemurian stage to reach and at times even to exceed the anthropoid type in smallness and close approximation.

CHAPTER XVIII.

DEVELOPMENTAL NEUROSES OF THE NOSE AND INTERIOR FACIAL BONES.

The bones of the nose follow the same laws in embryonic development and its arrest as do the other structures of the head and face. As, however, completion of the ossification occurs very nearly at that great period of stress, puberty, greater variations occur at that period even in seemingly otherwise normal individuals than with other bones of the head and face. This stress underlies the so-called "catarrh" of puberty.

Deformities of the nasal septum, deflection, hypertrophy and atrophy of the turbinated bones and deformities of the maxillary simuses, are generally associated with arrest and excessive development of the facial and maxillary bones. As it is possible to occasionally find deformities of the maxillary bones without deformities of the nose, so it is possible to find deformities of the nose without maxillary deformities.

Theile examined 117 skulls and found the septum normally placed in 29. Semeleder examined 49 and found the deflection to the left in 20, to the right in 15 and sigmoid deformity in 4. Harrison Allen, in 58 skulls, found narrowing to the left side in 19, to the right in 21; in six of the latter the septum and superior and middle turbinated bones met.

According to Zuckerkandl dry skulls do not give an accurate illustration of the true condition. His researches were made upon the cadaver; out of 370 cases he found 123 symmetrical and 140 asymmetrical; in the deformed specimens, the septum was inclined to the right in 57 cases, to the left in 51 and was sigmoid in 32. Mackenzie, on examination of 2,152 skulls in the Museum of the Royal College of Surgeons, found 1,657 cases where the septum was more or less deformed. In 834 the deviation was to the left and in 609 to the right. In 205 the deflection was sigmoid, while in 5 the irregularity was zigzag, showing 70 per cent of deformities in the dry skulls and only 40 in the cadaver.

Heyman's examination showed 99 per cent of deformities in living subjects. With the status already, there seems to be quite a difference in the percentages as regards races. Thus Zuckerkandl found in 103 cases of barbarous and semi-barbarous people twenty-four were asymmetrical. Mackenzie found in 430 skulls of superior races 22.0 per cent of deformities and also confirms the observation of Zuckerkandl.

Harrison Allen found in 93 skulls of negroes deformity of the septum in 21.5 per cent. I have examined over 11,000 in this country and Europe, including the large collection in the Museum of the Royal College of Surgeons, and 347 living individuals with the following results: Owing to the fragility of the septum the whole or anterior part was lost in many of the skulls, the results of which only 7,600 had sufficient bone remaining to give any idea of its shape. My examination of skulls in the Royal College of Surgeons, London, practically tallies with Mackenzie. In the 7,600 skulls, 5,762 showed marked deformities. Out of 687 ancient Peruvian skulls, 147 possessed deflection of the septum. In 69 stone-grave Indians, 35 were normal and 34 deformed. In 18 mound-builders, 8 were normal, 10 deformed; 6 California Indians, 4 were normal.

In a collection by J. M. Whitney, of Honolulu, of 28 skulls of ancient Hawaiians, taken from lava caves, the jaws were unusually well developed as well as the bones of the face. The external bones of the nose were also well formed. While there was a lack of that marked asymmetry due to excessive arrest of development of the turbinated bones, as noticed in Peruvian skulls, yet the bones were far from being uniformly located in the cavities of the nose. There were, however, two in which the inferior turbinated bones were undeveloped, only rudimentary ridges being present. Deflection of the septum was noticed in 23 cases—some in the anterior part of the bone, others in the middle, and still others in the posterior part. In the two cases where the inferior turbinated bone was undeveloped the septum deflected to that side. There were projections which seemed to take the place of the missing turbinated bones. One case was observed in which the deflection commenced midway, from before backwards, the greatest deformity being three-fourths of

its distance into the left cavity, midway between the turbinated bones. Upon that side of the vomer there was a large ridge, its greatest projection being about .25 of an inch in length. Upon the opposite side there was another smaller ridge, evidently for the purpose of supporting the deflected point, and also for the purpose of affording greater surface for mucous membrane and blood supply. Of the 347 living persons, 107 showed deflection of the septum.

Unlike Zuckerkandl, I do not find that dryness of the skull makes any difference; whether it be from a living subject, on the dissecting table, or skull that has been grinning from the shelf of a museum for twenty years. The two points of attachment are fixed (if the patient has reached puberty), and the septum, green or dry, cannot very well change its position, except there may not be quite so noticeable a deflection in the dry subject.

If the deformity were of a sigmoid (S-shaped) nature upon one side, the part of the bone or cartilage being dry would prevent its changing to the opposite side in the one case, or a reversal of the S-shape in the other. Diagnosis of deflection of the septum is more difficult in the living subject or cadaver than in the dry skull, because of the soft tissues located in the anterior part of the nose. This accounts for the small percentage of deformities reported by Zuckerkandl and myself. I found great difficulty in making my examinations upon living individuals; indeed, it seems almost impossible to discover the contour of the vomer in its middle and posterior parts, where they are as frequently observed as in the anterior part. This deformity was of all manner of shapes, sometimes like the letter S, again the letter C, and often like the small italic letter f. Sometimes it would be carried over so far as to approximate the right or left wall of the nose. From the fact that it is attached throughout at its upper and lower border to a solid, bony framework, its middle portion is liable to bend in any direction like a loose sail in the wind. Deflection of the vomer, due to fracture of the cartilage, or the deflection of the anterior part of the nose, is easily differentiated from a fractured vomer.

Several theories have been advanced as to the cause of these deformities. Quelmalz and Schultz believed they were due to

the action of astringents drying up the membrane, causing it to contract, thus drawing the bone and cartilage down upon itself. Morgagni believed they were due to excessive development of the vomer. Trendelenburg held they were due to a crowding up of a high-arched palate, as he had observed the two conditions frequently connected. Jarvis has reported four cases, all in the same family, and suggests they are due to direct hereditary defect, while neurotic or degenerate conditions which underlie the building up of the system may produce the deflection, direct hereditary here as elsewhere is rare. Schaus' and Welcker's investigations show there is a faulty development of the facial skeleton. Bosworth[1] and others believe that septal deformities are due to traumatism. According to Bosworth, "The clinical history of many of these cases affords direct evidence of this, and even in those cases in which the direct injury is not testified to, I think it safe to say that an injury has occurred, which may have been of so slight a character as not to have excited especial attention at the time of the occurrence. An injury to the nose need not necessarily give rise to the immediate development of a notable deformity, as in fractures, but it may set up a low grade of morbid action, which, going on through a number of years, will finally develop a condition by which the normal function of the nose is seriously hampered. The point on which I would lay especial emphasis is that the deformity is primarily the result of traumatism and secondarily of a slow inflammatory process which results therefrom." That deformity and fracture of the septum may, however, be traced to traumatism, I am personally well aware. In one case, when a boy of sixteen. I asserted my rights and received a blow upon the nose from my opponent which fractured the cartilage which made a lasting impression upon me. The theory from 50 to 80 per cent, or even 5 per cent of deformities of the septum are due to such injuries, is demonstrably illogical. In the large number I examined, 2,684 possessed what appeared to be fracture. The vomer in many of these specimens commenced to deflect at its outer surface and gradually deepened until at about its middle or posterior two-thirds, it reached its deepest part and then grad-

[1] Diseases of the Nose and Throat.

ually decreased in depth until the posterior attachment was reached. Its appearance was not unlike the sail of a ship. On the convex surface, in many cases, nature had thrown out provisional bone to support this curvature, which might be considered a break, but in most cases simply a bend. That a blow, whether slight or as powerful, could produce a fracture of the vomer, the greatest deformity of which is located from .75 to two inches inside the nose from the point of the nasal spine seems hardly probable. Anterior and posterior to this deflection, the vomer appeared in most cases to be nearly or quite normal. In nearly every case of fracture would involve only one-half of the vomer, the other simply bending; that such a condition could be brought about by a blow is absurd. It seemed the greatest deformity was the thinnest part of the bone.

It would appear to be a very easy matter in the skull to decide whether a fracture had taken place before or after complete ossification by the character of the wound, thus approximating the date of the injury. That it was caused by a low form of inflammation set up as a result of a slight injury in utero or after birth does not seem rational since the inflammatory condition must necessarily extend upon both sides of and through the septum extending its entire length. If due to an inflammatory condition the bend or break would be found at any part of the septum and the position and shape would be different in every case. As the location upon the septum, from above downward, is nearly always the same, and as the shape is always from before backward, inflammation could not produce it. In order to produce a fracture, there must be excess of septum. Therefore, unless the fracture is the result of a direct blow it would require years for sufficient growth and curvature to produce a condition in which fractures or even an abrupt bending could take place.

The theory the deformity is "primarily" the result of traumatism due to injury in utero or at the time of delivery or even subsequently, except by direct force and secondarily to a slow inflammatory process, will, therefore, not account for these deformities. Indeed, fracture of soft tissue, such as the vomer

before ossification, is not possible. The theory advanced by Trendelenburg cannot be maintained.

Wherever a high, contracted vault exists, a deflected septum is found. Often, however, a deflected septum is found without a high contracted vault. While the high vault and deflected septum go hand in hand, the one does not produce the other. It has been shown in the chapter upon the development of the vault, that it is developed downward and not up. The development of the suture, which unites at the median line, is precisely like laying the keel of a ship, only upside down; it is laid first and is the foundation upon which the superstructure rests. The narrow, contracted vault is, except in monstrosities, never seen before the sixth year. Many septa are deformed before that

Fig. 53.

date. There is nothing to cause upward movement of the vault. The ridge does not result from pushing down of the suture by the vomer. The vomer must be taut to accomplish this, but it is always bent in such cases. Again, if the ridge was produced by the action of the vomer it would be nearly or quite uniform in thickness its entire length, but this is never the case. If it were possible to crowd down the middle and posterior palate, it would be impossible to crowd down the anterior part of the palate, which is covered by the anterior alveolar process. I have frequently observed a ridge extending along and including the alveolar process as far as the incisor teeth. In 1,367 skulls, containing vaults so depressed, I have never found a corresponding depression in the floor of the nose.

It would be as impossible to force down the vault at the median line as it would be to force a keystone through a brick or stone wall by the weight resting upon it. The author, and others, have shown that deformed septa are common among early and pure races, who do not possess contracted arches; so that it will be seen that one is not dependent upon the other. As regards length of septum, I agree with Morgagni, that it has developed beyond normal, and in order to accommodate itself to its surroundings, it must deflect either to the right or left.

In some cases the right side has the preference, in others

Fig. 54.

the left side is more favored, while again, there is an even division as regards deformities.

The first seven cases which I shall choose for illustration of this point are Peruvian skulls from Harvard college. The cases seen in Figs. 53 to 56, inclusive, are well developed, while those in Figs. 57, 58 and 59 are arrested in their development. These photos were arranged so as to get as much light into the cavities as possible. Some, however, are quite unsatisfactory, for, while they show the septum, the turbinated bones and surrounding parts are not well illustrated. Fig. 53 shows the septum deflected to the left—resting upon the inferior turbinated bone of that side. The right turbinated bones (which are poorly shown) are excessively developed, to such an extent that while they do not quite touch, they take the contour of the nasal septum. Fig. 54 shows a similar condition,

while the nasal septum is not deflected quite as far. The right superior turbinated bone is excessively developed, but not to the extent of the inferior one. Fig. 55 shows a septum almost straight. The left inferior turbinated bone is well shown. The other turbinated bones are also excessively developed, but do not extend so far forward. The septum is divided into two parts. It will be observed that in the other two, unlike this one, the turbinated bones are arrested in their development upon one side, and excessively developed upon the other. Both cavities are entirely, but uniformly, filled with complete masses of soft, spongy portions of the turbinated bones. Stigmata are marked in the skulls, while the cavities of the nose are smaller, or arrested in their development. The two sides of the

Fig. 55.

face are quite unlike, and the orbits are very much undeveloped. There is a marked arrest of development of the left maxillary bone, which contains an antrum only about one-half the size of the right side. The arrest of development has caused the teeth to be forced out on a large circle, in order that they may come in contact with the lower teeth. This action has caused the roots of the teeth, in many cases, to protrude through the outer plate of alveolar process. The mastoid processes are also excessively developed. A profile view was taken of this skull (Fig. 56), in order to obtain as good a view as possible of the large right inferior turbinated bone. This bone is so large that it extends nearly to the floor of the cavity. The most remarkable point in regard to this deformity, outside of the excessively

developed turbinated bones, is, that not only is the septum deflected to the left until it rests upon the wall of the cavity, but that the nasal spine is also deflected. In Fig. 57 are seen nasal cavities arrested in their development. The septum is but slightly curved to the left. The nasal cavities are filled with excessively developed turbinated bones, and the spaces between the turbinated bones and the vomer are about evenly divided. In Fig. 58 is seen a very small nose, the vomer is deflected to the left below, and at about one-third of the way up it takes a decided turn to the right. In the examination of the turbinated bones the right inferior bone is very large, the left very small, while the reverse is the case in the two upper bones. In Fig. 59 are seen stigmata of degeneracy in the nasal cavities. Here the

Fig. 56.

vomer is about straight, while the turbinated bones upon both sides are so large that they fill the cavities; the spaces between, however, are uniform upon both sides. Deflection of the septum and excessive development of the turbinated bones are hence associated with large, well-formed nasal cavities, as well as with small, contracted cavities in ancient as well as modern people. The same relation exists between the vomer and turbinated bones in all the skulls as well as in living persons. The extent and location of the deformity depend upon the extent of development and location of the turbinated bones. They may not necessarily be excessively developed or arrested in their development, but if the outer walls be small, reducing the size of the nasal passages, and the turbinated bone unevenly situated or

nearly filling the cavity, the septum will deflect to the right or left and conform to their shape, leaving uniform spaces throughout the entire length of the bone. Inhalation and exhalation cause the vomer before or during ossification to deflect to the right or left, according to the size and location of the turbinated bones. The air striking the septum, just as the wind strikes the sail of a boat, produces uniform spaces between the septum and turbinated bones. The bend or breakage is almost invariably at a point of the concavity just midway between the two turbinated bones on that side, and at the thinnest part of the vomer. When the turbinated bones are undeveloped upon one side and excessively developed upon the other, the force of air causes the vomer to bend toward the smaller turbinated

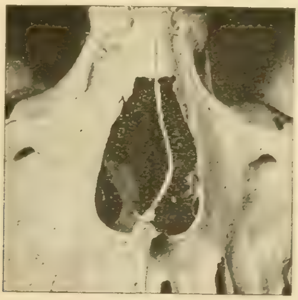

Fig. 57.

bone, thus lengthening it, so that the air will enter and leave uniformly upon both sides, as illustrated in Figs. 53 and 54. If the turbinated bone is large upon one side, the force of air will cause the unossified vomer to develop, and if the cavity of the nose is large, the whole volume of air will eventually strike the vomer upon one side, causing it to bend right or left until the air is uniformly distributed or it comes in contact with the turbinated bones upon the opposite side. In Figs. 57 and 59, the turbinated bones, developing nearly uniformly upon both sides and filling the nasal cavity, give no opportunity for the septum to deflect to the right or left. The spaces, therefore, are uniform upon both sides. It is also safe to say that when these bones are covered with mucous membrane that the nose

was completely filled, and that these persons were mouth-breathers.

Associated with unstable development of the superior maxilla and bones of the nose, must necessarily occur unstable development of the mucous membrane, resulting in a thickening of the membrane and adenoid growths. These conditions are almost always to be found in connection with stigmata of degeneracy. Idiots, imbeciles, etc., patients possessing (apparently) high vaults, are hence mouth-breathers. There is an arrest of development of the bones of the face, jaw and nose. The patient cannot breathe through the nose; the mouth being open the teeth and alveolar process develop down for want of antagonism;

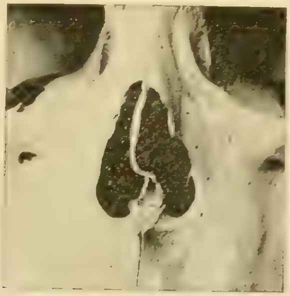

Fig. 58.

and the contracted vault, which looks high because of the arrest of development, results.

It is quite common to find entire arrest of the inferior turbinated bones upon one side or upon both sides. Again, one or both inferior turbinated bones will be partially developed.

The following skulls, in the Army Medical Museum at Washington, possess such deformities:

Alaska Indians—

- Skull No. 1,090, case 177; lower right turbinated bone undeveloped.
- Skull No. 1,092, left inferior turbinated bone undeveloped, vomer gone.
- Skull No. 1,094 both inferior turbinated bones undeveloped.

Skull No. 2,431, no inferior turbinated bone.
Skull No. 2,453, no inferior turbinated bone.
Skull No. 2,798, no inferior turbinated bone.
Skull No. 2,451, no left inferior turbinated bone.
Skull No. 1,216, case 180; both inferior turbinated bones undeveloped.

Many Peruvian skulls show undeveloped inferior turbinated bones. Thus:

Skull No. 630, case 166; no right inferior.
Skull No. 631, case 166; no right or left inferior.
Skull No. 115, case 167; no left inferior turbinated bone. Individual over twenty-two years of age at time of death.

Fig. 59.

Excessive development of the turbinated bones is also very common. Thus, No. 2,131, case 175, Vancouver Island Indians: The right middle turbinated bone is excessively developed, so that it fills the anterior middle of the nasal cavity with a large cavity in the center. The left middle and right and left inferior bones were well developed, filling both nasal cavities. In this case the vomer, which stands uniformly between the turbinated bones, takes the shape of the letter S. No. 2,129, Vancouver Island Indians, shows left superior turbinated bones; excessively developed to a level with middle turbinated bone. The vomer is deflected to the right, then to the left, in order that it may stand in a central position. Skull 1,309, case 173, illustrates the theory of the author very nicely. The right middle turbinated bone undeveloped, inferior right excessively devel-

oped; the vomer at its middle takes a V-shape, in order that it may stand in the middle between the turbinated bones.

That inhalation and exhalation govern the development and shape of the bones of the nose is shown in many ways. When the nasal cavities are small and the bones become enlarged upon one side, the outer wall will become concave, encroaching upon the antrum. Again, when the nasal cavities are small, the turbinated bones will develop and curl upon themselves so that uniform space is obtained for the passage of air. In a long, narrow nasal passage the bones will develop long and narrow; the superior turbinated bone will develop down, sometimes below the lower edge of the superior turbinated bone. In other cases the nasal cavities will be short and broad. In these cases the

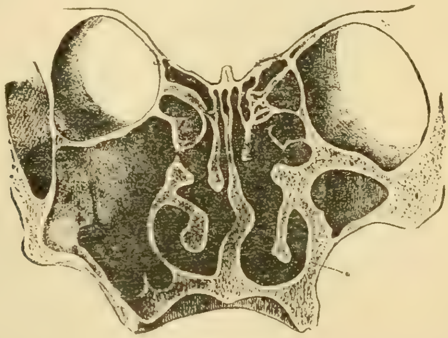

Fig. 60.

bones will become large and short. They may develop straight out from the outer wall, and then turn upon themselves back to the point of origin. Sometimes they are very thin and dense, like the vomer. Again, they are thick and cancellated, like the spongy alveolar process. Occasionally one nasal cavity will be lower than the other. In such cases a corresponding deformity is almost sure to result in the vault. When the nasal cavities are not uniform in development—that is, narower in front than behind—the turbinated bones will develop posteriorly, and either become undeveloped anteriorly or will curve more, so that air may be evenly distributed throughout the cavity. When the turbinated bone develops larger or smaller behind than in front, the bone will bend upon itself to conform to this deformity.

Skull No. 736, case 179, has also a very marked deformity of the vomer; it is bent in both directions. The anterior half is midway between the turbinated bones, while the posterior half is bent to the right, the greatest point being between the right upper and lower turbinated bones. Both concavities have projections—one to the right, the other to the left. The anterior curvature of the vomer is the largest, and for this reason the left turbinated bone is undeveloped. This, however, does not allow sufficient room for the air to become evenly distributed through the nostril upon one side. The most remarkable thing is that to procure room the air had forced the vault of the mouth on

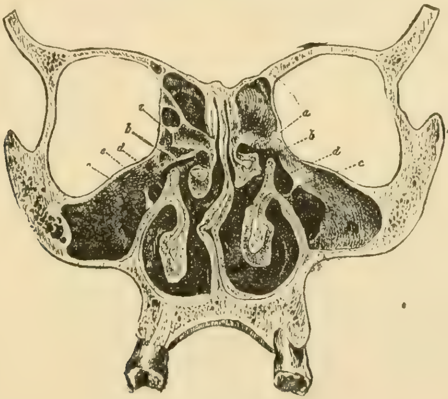

Fig. 61.

that side downward, making a very marked and noticeable deformity. The dental arch is well developed.

Occasionally the turbinated bones are so situated that the air will deflect the vomer to one side or the other in such a manner that there will be a deformity at right angles, just below the inferior turbinated bone. This, however, cannot be located very near its place of attachment, for the reason that the vomer commences to enlarge or thickens as it reaches the nasal spine, thus preventing the bend.

The drawings of Zuckerkandl are here given because they illustrate the points made, and are true to life.

Figure 60 shows the bone very unevenly developed. This is partly due to an excessively developed antrum upon the left

side and a correspondingly small one upon the right side. It will be noticed that the turbinated bones and vomer are so distributed that there is a uniformity of space throughout the cavity. The vomer even has deflected to the right in order to produce this harmony. It will be observed, however, that the bone is not broken, but simply bent, and that this bend is almost opposite the enlarged left inferior turbinated bone. Although the face is very asymmetrical, the bones, which are intended for the purpose of warming the air, are nicely arranged. The right cavity is considerably lower than the left; the inferior turbinated has lengthened to correspond. Aspiration has separated the lateral halves of the vomer, and the space has filled in with bone.

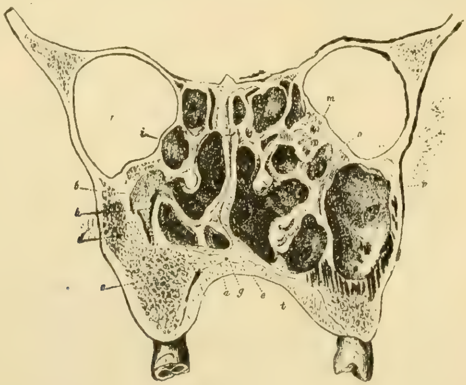

Fig. 62.

Figure 61 presents quite another state of things. Here the facial bone is uniformly developed; the antra are comparatively uniform; the turbinated bones, however, are very unevenly developed. The bend and break in the vomer are about at a point betwen the two turbinated bones, and exactly opposite the excessively developed right inferior turbinated bone. It will be observed that the bend is no greater in the one than in Fig. 60, and yet in Fig. 61 the left plate is fractured, while the right one is slightly bent. This is usually the case. There is not a complete fracture, but a semi-fracture.

Figure 62 shows still a different condition. The left antrum is nearly closed; to compensate for this a number of sinuses are formed. In order that the air may be warmed uniformly the

septum has developed to the left. The lower part has enlarged, and the middle has deflected to the right, thus giving a more uniformity of spaces. The right inferior turbinated bone has also enlarged for the same purpose.

Fig. 63 is an excellent illustration of arrest of development of the bones of the face, nose and jaws. The bones are very unevenly developed, with excessive development of the left superior turbinated bone, which has a cavity in it no doubt for the purpose of producing more surface for the blood supply. An individual with such a development must necessarily possess a degenerate condition, with weak lungs, small chest, and low vitality. In order that the air may be uniformly warmed the

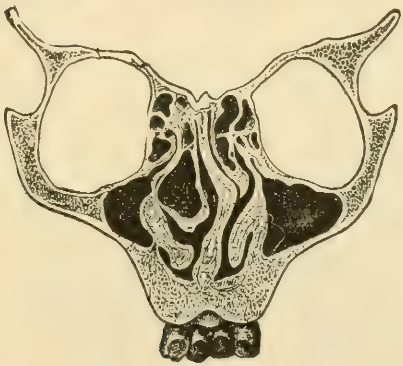

Fig. 63.

septum has deflected toward the right. The vomer has deflected toward the right in order that the turbinated bone may have room, and also to furnish uniform space. The septum in this case is bent and not broken.

Fig. 64 is another form of deformity which I have occasionally observed. In this case the nasal cavities extend laterally nearly outside of the alveolar process. Were one to undertake to open the antrum through the cavities of the teeth he would drill into the floor of the nose. I have observed such cases. Having such a large space the turbinated bones have adjusted themselves to the best advantage. The septum also has adapted itself as best it can by deflecting toward the left side, having bent itself at its weakest part and opposite the enlarged turbinated bone. There is, however, a large space upon the right side

between the two turbinated bones. The thickness of the bone prevents its being bent by the pressure of air, and excessive development of the vomer has taken place upon that side as a substitute.

Fig. 65 shows the turbinated bones upon both sides excessively and uniformly developed, the result of which is that the vomer is straight upon the left side, while the right half has been torn away, and by aspiration the air has drawn it slightly into the space between the two bones.

Figs. 66 and 67 are drawings taken from frozen specimens in the Army Medical Museum at Washington, showing that the parts of fracture and deflection are situated between the turbinated bones.

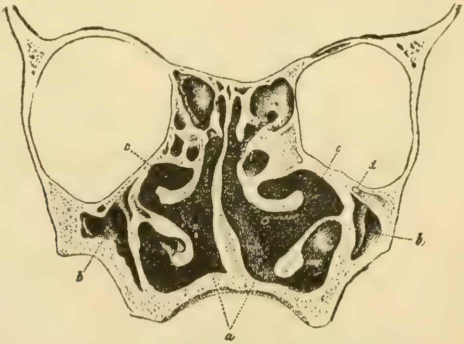

Fig. 64.

A skull in my possession is that of a girl fourteen years of age, who died of consumption. There is hardly a bone which goes to make up the skull, including the lower jaw, that does not show stigmata of degeneracy. The left inferior turbinated bone did not develop. A simple ridge is present where the bone should be attached to the outer wall. The right inferior turbinated bone is excessively developed. The vomer has curved to the side where there is space and from the enlarged right turbinated bone. Although there is quite a bend, still, owing to the fact that the girl died at the age of fourteen, this is not as marked as it would have been had she lived.

Another case is that of a bone projecting .36 of an inch, (situated upon the right side of the vomer just midway between

the superior and inferior turbinated bones), .75 of an inch in length, 1.50 inch in from the nasal spine, and .50 of an inch from the posterior border, which is comparatively straight. The anterior part is slightly curved, but perfectly straight .50 of an inch anterior to the commencement of the deformity. There is a slight groove upon the opposite side of the vomer to correspond to the line of projection. It stands just midway between the two turbinated bones. This is not a fracture, nor can it be claimed that the projection is for the purpose of repairing a fracture. The length of this projection would alone preclude such an idea. These projections vary from a mere ridge up to a

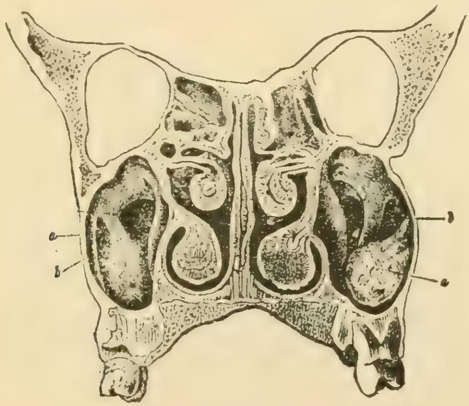

Fig. 65.

projection .36 of an inch in width. It would seem that nature, being unable to develop the bone sufficiently to carry it far enough, built out a projection in order to complete its design.

These projections were first mentioned by Langenbeck, who gave to them the name of exostoses. They were afterward described by Theile, Harrison Allen and John Mackenzie. "These projections," according to Bosworth, "are always found along the sutural lines of the septum, and consists in a more or less well-developed angular prominence or ridge, which projecting into the nasal passage, acts to obstruct normal respiration."

This has not been my experience. I have always found them situated upon the convex surface, and the greatest projection

being at the weakest point of the septum. As the greatest deformity may be located at any point between the anterior and posterior edges of the bone, the greatest point of projection may occur on any part of the septum, but always situated midway between the turbinated bones. This projection is due to irritation, from inhalation and exhalation.

In deviation of the vomer to the right or left, with a decided depression always at a point where there is the greatest space; sometimes in the anterior part of the bone, and often in its posterior part; sometimes high up, and again low down, depending upon the location of the turbinated bone, with a rib of bone developed upon its convex surface. It seems to be a super-

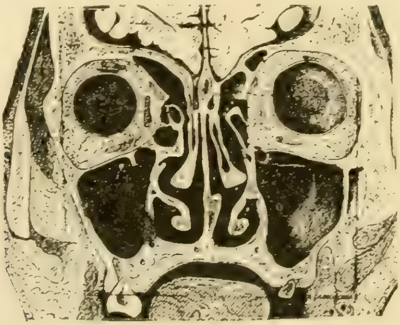

Fig. 66.

numerary turbinated bone. The deflection and the supernumerary turbinated bone compensate for the space on either side of the nose. Just as the intelligence of the individual depends upon the amount of gray matter in the brain, and the gray matter depends upon the number of lobes or convolutions, so the warmth of air which is taken into the lungs depends upon the amount of blood, the blood upon the amount of mucous membrane, and the mucous membrane upon the contortion of the bones of the nose to produce surface. If they are arrested upon one side, those upon the other enlarge or elongate, and thus make up for the deformity. When the inferior turbinated bone is entirely arrested the bend in the septum and projection seems to compensate for the loss. In neurotics and degenerates, in many cases, the lungs and the chest walls are undeveloped and very delicate.

The deformities take place before puberty, and in a majority of cases before the sixth year. The arrest of development of the jaw takes place at the time the second teeth erupt, and the arrest of the nose and face shows that the individual possesses a face of that age.

The width of the external nasal cavity varies considerably. In 2,000 cases, the greatest width was 1.25 of an inch; the smallest width was .75. The length from the nasal spine to the edge of the nasal bones was (greatest length) 1.54 and the smallest 1.20 of an inch. These skulls, however, are made up of Peruvians, stone-grave Indians, mound-builders, cliff-dwellers, Hawaiians, etc., etc. In neurotics and degenerates, when arrest

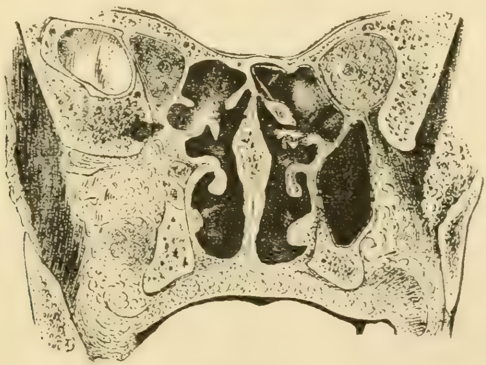

Fig. 67.

of development of the face and nose had taken place, I found that the width measured .50 to .60 of an inch, and the length .80 to .90 of an inch. In these cases, if the turbinated bone developed uniformly, the vomer will be straight. If asymmetry exist, the vomer will be deflected to one side or the other, in which case the bone, when covered with mucous membrane, will fill the cavity of the nose and mouth-breathing will result.

On general view of the nose, a want of harmony in its general outline in many cases is seen. The nasal bones become arrested in their development, and the tip of the nose is turned up, owing to a normal or excessively developed cartilage. Another and very marked deformity is one in which the nasal bone and cartilage are excessively developed. The bone takes one angle and

the cartilage another, producing a double nose. This condition is very common among Hebrews. There are, however, Americans who have nasal organs containing material enough for two fair-sized noses. In a majority of these cases there is a total collapse of the walls of the nose, and frequently mouth-breathing results.

Fig. 70 illustrates such a case, although the nose is not nearly as large as these two I have just described. This illustration, however, gives a fair idea of such cases. In over 2,000 measurements of the nasal bones, the shortest was found to be .40, the longest 1.65 of an inch in length. It will be seen that even the bones without the cartilage would make a fair-sized nose. These bones take different angles. It would seem that those which are the largest take the greatest angle. A form of deformity, which is more common than is generally supposed, is that in which the nose is deflected to the right or left. This deformity, however, is often so great that it produces a marked asymmetry of the face, and often so slight as to be unnoticed by the average observer. There is no doubt that it is carried to the right or left by the cartilaginous septum, when only the soft tissues are involved; but when the bones of the nose are deformed, quite another condition exists. Marked deflection, as well as other deformities of the nose, are not observed in early life, but as the face develops the deformity becomes more prominent, and at puberty is well defined, although it does not reach its full development until twenty-five or thirty years. In most every instance the two lateral halves of the face are asymmetrical, as well as the nasal bones. The bones of the nose develop upon one side and deflect the lower border to the opposite side, where the bones are undeveloped. This has a tendency to deflect the cartilaginous septum in the same direction, which, in turn, exaggerates the deformity. Noses in neurotics and degenerates may be deflected nearly 45° from a normal position. The claim has been made that these marked deflections are due to injury in utero or at birth. As the bones of the nose are undeveloped at birth, and as marked deflection is not observed until later in life, such a theory does not fit the case.

At birth the nasal cavities are not evenly developed. If one

side is larger than the other, more air will pass through one side than the other. If the two sides are nearly even, the amount of air will be about uniformly distributed.

Ziem has shown that if one nostril of a rabbit be permanently closed and the animal killed after it has attained its full growth, the nasal cavity of the affected side will be found to be undeveloped, and asymmetry of the face will have taken place. This is also the case when one side is undeveloped; the air passes through the opposite side and the passage becomes enlarged. A greater quantity of air passing through, a greater surface of mucous membrane is required to warm it. The turbinated bones become physiologically enlarged, owing to the stimulation of the air, and the vomer is carried to the weak side. The undeveloped condition of the nose and asymmetry of the face of animals, as demonstrated by Ziem, can be accounted for in no other way than a want of stimulation of air inhaled and exhaled.

The septum ossifies much slower than the surrounding bone, and therefore it is more easily moved out of its normal position. At, or about the sixth year, the deformity is well established. The air stimulates a physiological development of the septum, and it bends toward the undeveloped side. It grows faster than the points of attachment, and as a result the septum, according to the law of mechanics, bends toward the smaller part. When inhalation takes place, the air passing through the undeveloped passage, produces suction, thus drawing the bone toward that side; while upon the other hand, the large volume of air passing through the large nostril, forces it in the same direction. Thus, by aspiration and pressure, the thinner part of the bone is bent to the weaker side, which gives a uniform space for the pressure of air throughout the nose. The location of the deformity depends upon the asymmetry of the two sides and the thinness of the vomer. Close examination of section of the vomer shows projection upon one side or the other, and sometimes upon both sides, due to fracture or excessive development of bones that they are always located between—the turbinated bones. They are not just in the center, but not far from it. These are also the result from stimulation by exhalation or aspiration of air, producing healthy physiologic action at that point.

When a slight irritation of the mucous membrane takes place, as a result of cold, it thickens. The child experiences difficulty in breathing. In the spasmodic effort to draw air into the lungs through the nose a vacuum is formed and the septum is developed and drawn to the point of least resistance, which would naturally be at a point between the turbinated bones. In this manner the septum takes the outline midway between the bones. The fracture very rarely extends through the two halves of bone; only one side breaking, while the other is simply bent. The fractured half being always upon the convex side leads to the opinion that it is due to (1) the thickening of the mucous membrane, (2) accumulation of moisture or purulent mucus, and (3) an excessive effort on the part of the patient to draw air through the nose. This being impossible the vomer is drawn into the space after partial ossification has taken place, and, as a result, fracture of that half and simple bending of the other half. The edges of the broken half are torn apart from the other half, producing a space between, which is eventually filled up with bone cells. This condition is not unlike the fracture of a green stick. Sometimes it will be drawn to the right side in one place and to the left in another. Again, in the same manner, the two lateral halves are separated their entire length, as illustrated in Fig. 55. There is a projection of the right half at a point midway between the right turbinated bones. This seems to be only natural, since, in many cases, the deflection and fracture only extends a short distance in the anterior middle, or posterior part of the vomer, while the bone will be perfectly straight anterior and posterior to the deformity. The shape of the deflection and fracture can be accounted for in no other way. In order that fracture may take place, the vomer must have ossified partially or completely, which occurs at middle life; therefore injuries in utero or subsequently, before ossification, are out of the question. If the turbinated bones be uniformly developed the vomer will, in most cases, remain quite or nearly straight. The force produced by drawing air will frequently separate the two halves and, occasionally, produce one fracture upon one side, the other upon the other side. Not only are the cartilages of the nose brought in close relation to each other, but, occasionally,

the force is so great that there is a total collapse of the outer bony walls and they are drawn toward the septum, making a groove upon either side, the nasal bones remaining perfectly flat at the upper edge.

Deviation of the nasal septum to one side or the other is the result of an unequal development of adjacent bony parts, more especially and directly of that of the turbinated bones. It depends largely, if not exclusively, upon the development and position of these latter. They, in turn, are dependent in great measure upon the development of the facial bones, which are

Fig. 68.

modified as the facial angle increases and prognathism is lost. The turbinated bones being, as it were, exostosed, not molded in many directions by adjacent parts, encroaching more irregularly upon the nasal cavity, as their origins are disturbed or dislocated. Freedom of these nasal passages for transit of respired air is essential. In normal respiration the tendency is for both nostrils to share equally. The natural consequence is, that the vomer, the ossification of which is incomplete until puberty, is deflected and occupies, as a rule, nearly a midway position between the bony prominences on either side. Deflection of

the septum hence is compensatory arrangement for the evolutionary variations of facial development. It is therefore most frequent in the higher races, while in the lower its occurrence is markedly less.

Instability of tissue-building is to be expected in neurotics and degenerates. It is easy to see how, with such an unstable bone tissue to build upon, the mucous membrane of the nose can take on atrophy, hypertrophy and adenoid growths, resulting in mouth-breathing.

Total collapse of the outer walls of the nose is frequently

Fig. 69.

observed among neurotics and degenerates. This is associated with arrest of development of the bones of the face, jaws, deformities of the dental arch, weak, contracted chest, round shoulders, husky voice, etc. In most cases of this description the nose is very long and thin. The nasal bones are excessively developed or arrested, with marked deflection of the septum. Frequently nasal catarrh is present. When the patient attempts to inhale air the outer walls are brought together and nose-breathing is impossible. The result is mouth-breathing, not only taking cold air into the lungs, but also diseased germs. The preceding illustrations (Figs. 68, 69 and 70) are those of persons who

possess all of the signs herein enumerated. These pictures are front views of those used in the chapter upon deformities of the face, and are intended to illustrate the long, slender nose. By comparing these with those representing the side view, a very good idea of the thinness may be obtained. Three of these persons are now infected with tuberculous deposits, and the fourth will require the best of care to prevent infection. It is possible for persons to contract tuberculosis who do not present stigmata, but parents who have children possessing the somatic conditions here noted should pay particular attention to early hygienic welfare.

Fig. 70.

The type of the antrum (which depends on the variations in evolution of the face and the further variations dependent on the nature of the transitory structures with which it is connected as well as on the periods of evolutionary stress) must be extremely variable. It is, hence, not surprising that as I have pointed out nearly a decade ago the variability of the antrum cannot well be overestimated. In a general way it may be said the length, height, location and width is governed by the shape of the face and by the type of the nose and of the superior max-

illa. The shape and position of the antrum hence vary widely. Thus in one case the cavity may be very small and resembles a crescent with its concavity toward the nasal wall, its convexity toward the molar process. It may not be large enough to admit the end of the little finger and may not extend as far laterally as the inferior orbital opening. The oppoiste side may be similar in shape and extend just beyond this opening. Sometimes the antrum upon one side will be very long while that upon the other is very small. Usually the nasal cavity will be carried over nearly one-half of its size to the side of the smallest antrum. There is sometimes soft, cancellated bone extending from the alveolar process into and filling the antrum, leaving a number

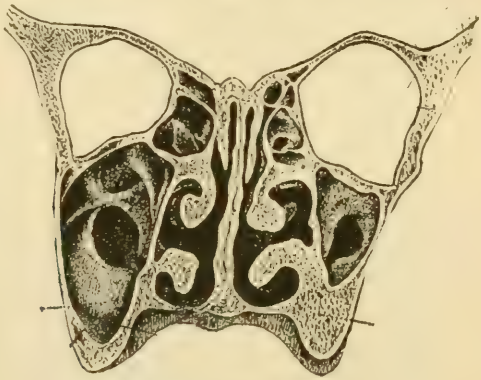

Fig. 71.

of small openings or sinuses which resemble the ethmoidal cells. In these cases the contour of the face is also very much disfigured, a drill passed through the alveoli of the first and second bicuspids would not reach an opening.

Although the antrum is usually regarded as a triangle it assumes even in normal subjects a great variation from this shape. The variations which may occur are best illustrated in the contrasts between the following cases. The first three have nothing degenerate recorded in their history.

In Fig. 71 is seen a jaw and nasal bone of a person certainly in later life. After all the teeth had been removed absorption of the external surface of the alveolar process had been proceeding for many years. The roundness of the alveolar pro-

cess, the ridge of bone in the vault and the vault itself indicate this to be the case. An alveolar process the size and shape illustrated here could only develop with the second set of teeth. It will be observed the left antrum is unusually large; that it extends up to and encroaches upon the left orbital cavity and quite a distance along the inner border. It also encroaches upon the left nasal cavity and downward into the alveolar process. The right antrum is very small as a result of which the alveolar process is very large and extends quite a distance into the floor of the nose. To compensate for this want of harmony in the development of the antrum, the turbinated bones have become enlarged, and, although the nasal cavities have developed con-

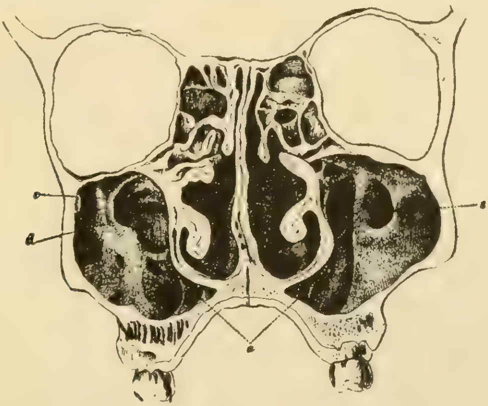

Fig. 72.

siderably to the right of the face, all the bones of the nose have so arranged themselves there are uniform spaces between them. If the teeth in this individual remain the usual number of years (this illustration represents a person from forty-five to sixty-five years of age), the only absorption that could possibly take place would be at the outer border of the alveoli.

Fig. 72 not only shows the antra extending toward the median line upon both sides encroaching upon the nasal cavity, but there are also ridges of bone and septa extending through the cavity. This is likewise the case in Fig. 71.

Case I is that of a prostitute. Width of dental arch, 2.25. The antrum upon the right side extends back as far as the third

molar, forward to the canine eminence from the lower border of the alveolar process to the floor of the orbit, the cavity was triangular in shape, the apex being downward at the alveolar process; the base being the floor of the orbit. Its length of the lower part was 1.50, at the upper 1.75, height at the posterior part 1.75, anterior 1.50, width below .25, at the upper .62 of an inch. The cavity was divided into two parts by a septum of bone .50 of an inch in height; another septum of bone extended horizontally along the inner side opposite the inferior orbital ridge. The left side of the superior maxilla was very much arrested in its development with a marked protrusion of the alveolar process and teeth to make a respectable dental arch to correspond to that of the other side. The antrum extended from the third molar forward to the second bicuspid. The length of the antrum at its lower part measured 1; upper part, 1.50; height at the anterior part, 1.24; at the posterior part, 1.60; width at lower border, .36, at upper border, .50. The apex in this case was located at the malar process, its base being the outer wall of the nose. A drill passed into the cavity of the first bicuspid upon the right side would penetrate only one-half of the antrum, while it would require an opening of the second molar to drain the posterior cavity. In either case the drill would have to travel only about .25 an inch from its outer border. If a drill were carried into the antrum at the anterior root of the first permanent molar upon the left side, it would have to pass .75 of an inch to reach it.

Case II is that of an Irish epileptic degenerate. Width of dental arch 2.75; vault is .84 in height; jaws are very large and massive. The antrum upon the right side extends from the posterior surface of the third molar forward at the lower border to the anterior root of the first permanent molar, at the upper border on a line with canine eminence. Over the root of the second bicuspid there is a very marked depression, showing the walls of the antrum unite at that point. The cavity is almost square, as will be seen by the figure; length of lower border, 1.12 of an inch; upper border, 1.52 of an inch; height of anterior part, 1.25; posterior, 1.20; width below, .75; above, .80. To reach the antrum at the second bicuspid the drill would have to

travel 1.25 from the lower border of the alveolar process; at the anterior root of the first molar .75 from lower border. The antrum upon the left side extended .50 of an inch back of the second molar (the third molar not being present), forward to a point over the root of the second bicuspid; the upper part extended as far as the canine eminence. Length of lower border, 1.25; upper, 1.75; height anterior, 7; posterior, 1.25; width, .75; lower border, .78; upper border, .80. To reach the antrum at second bicuspid the drill would have to pass 1, with difficulty in reaching it; at anterior root of first molar, .84. Both cavities are free from septa.

Case III is that of a criminal. The third molar was never present upon the right side. The antrum therefore extended .50 beyond the second molar forward as far as the anterior root of the first permanent molar on the upper border to a point above the canine eminence. This cavity possesses a very peculiar shape, as will be noticed in the figure. Length of the lower border, 1; upper, .84; triangular in different directions. First apex at outer surface of malar bone base outer plate of the nose; second apex anterior near the nose and base toward posterior surface. The roots of the first and second molars penetrate the antrum as in illustration. The antrum could only be reached by going through the outer plate of the alveloar process of the first permanent molar. The antrum upon the left side extended from the posterior surface of the second molar forward to the first permanent molar. Length of lower border, 1.25; upper, 1.75; height anterior, .75; posterior, 1.25; width lower, .50; upper, .60. This was a very remarkable cavity. The roots of the second and third molars penetrated the floor of the cavity abscess had appeared upon the buccal roots of the first molar without injury to the floor of the antrum. The outer wall of the nose had bulged into the antrum in its entire length and width from the lower turbinated bone to the floor of the nose. The inner and outer walls of the antrum had become united at about its middle by a septum making two distinct cavities.

Case IV is that of a pauper. The antrum upon the right side extended .50 of an inch beyond the third molar forward at the lower border as far as the second bicuspid; at the upper border

to a point over the canine eminence. The apex of the triangle in this case is located at the junction of the wall of the nose and floor of the orbits. The base was formed by the outer surface and malar process, a ridge dividing the anterior part of the antrum into two cavities extends from the floor of the orbit down about half the depth of the antrum at a point of exit of the naterior orbital nerve and artery. The outer wall of the nose curves into the antrum filling it about one-third full. It will be seen, therefore, the cavity is very irregular in shape. Its length at the lower border is 1.12; upper border, 1.38; height anterior, .75; posterior, 1.25, with lower border 36, upper 1 inch. The molar teeth extend into the floor of the cavity. Arrest of development of the maxillary bone upon the left side necessarily causes the antrum to be much smaller than upon the right side. Like the right antrum it extends .60 of an inch beyond the molar, its lower border extends forward to the anterior root of the first permanent molar, its upper border to a point over the cuspid teeth. Length of lower border, 1; upper, 1.25; height anterior, .75; posterior, 1.25; width lower edge, .25; upper, .92. The palatine roots of the first and second molars penetrate the floor of the antrum.

Case V is that of a prostitute. The right antrum is very small and extends back to the posterior surface of the second molar, the third molar not being present From the lower border of the antrum to the lower border of the alveolar process is .75 of an inch, the roots of the teeth therefore do not reach within .25 of the floor of the cavity. The length of the lower border is .75; upper, 1.12; height of the antrum, .60; posterior, 1; width of lower, .25; upper, 1. A septum extends the entire length of the outer and inner walls except a space about the size of a lead-pencil dividing the antrum into almost two distinct cavities. The left antrum extends to the posterior border of the third molar; the cavity is slightly larger than the other although the alveolar process is just as large and therefore the anterior border so far as the teeth are concerned has no relation to this. The length of the lower border, .86; anterior, 1; width, .28; upper, 1.20. This cavity contains a number of septa running in every direction. The nasal bone bends inward and in

every way shows stigmata of degeneracy. If a drill were to be carried into the antrum through the roots of the bicuspid it would have to travel .60 of an inch and then would not reach the lowest point. We are not warranted in making openings into the antrum through the root canals of the molars because they rarely incline in the direction. The drill would pass either into the floor of the nose or out at the cheek.

The following figures here illustrate stigmata of the antra and the difficulty of always reaching the floor of the antrum by passing a drill up through the alveolus for the purpose of drainage. In Fig. 60 the left antrum is seen to be excessively developed. The base of the cavity, located at the floor of the orbit, the apex near the borders of the alveolar process, extends quite a distance toward the median line and under the nasal cavity. It even encroaches upon the left nasal cavity at its upper border. A drill would pass without trouble into this cavity through the palatine or even buccal roots of any of the molar teeth. Quite a different state of things is noticed upon the right side. The nasal cavity is carried over and occupies the space where the antrum should be located. The antrum is very small upon the inner surface of the malar process under the eye. A drill passed through the alveolus would certainly enter the floor of the orbit. In Fig. 61 both antra are seen so located that the drill passing through the alveoli would not penetrate, but in both cases the floors of the nasal cavities would be punctured. The left antrum (Fig. 62) is almost entirely obliterated. Stigmata are not only seen in the antra, but also throughout the nasal bones and ethmoidal cells.

To reach both antra by drilling through the alveoli, could only be accomplished with difficulty. The cross section (Fig. 63) was taken so far forward that description of the antra is out of the question.

In Fig. 64 the antra are seen to be so small as to be almost obliterated. The nasal cavities, however, are so large that the floors of these cavities would be punctured if a drill was passed through the alveoli.

Some years ago I recorded a case in which a patient, had an opening drilled through the cavity of the second bicuspid

to relieve the antrum, and the drill passed into the floor of the nose. At that time it occurred that there was gross ignorance on the part of the operator as to the location of the antrum. An opinion I have since changed.

On examination of skulls, I have discovered some eight cases where the floor of the nose was so wide and the facial bones so deformed that the long axis of the roots were directed into the floor of the nose. In each case the floor of the nose would be perforated were the operator to drill through the palatine buccal roots of the first or second molars. I have frequently observed arrest of development of the maxillary bone on a line with the alæ of the nose, when the alveolar process (in order that the teeth might antagonize with the lower teeth) extended outward to such an extent that the apices of the roots of the bicuspids would point entirely outside of the line of the antrum. Hence the alveoli are not a reliable route by which to reach the lowest point in the floor of the antrum, nor is the operator sure of reaching it at all. It is easy to see how in a very few cases the development of the antrum and nasal cavities might be such, together with the thinness of the alveolar process, that the roots of the teeth may penetrate the floor of the antrum (Fig. 73). These cases, however, are very rare. In most cases, owing to the thickness of the alveolar walls and the position of the antrum, the roots of the teeth will not reach it. The roots of first and second bicuspids almost never enter the floor of the antrum. The roots of the first permanent molar in its relation to the antrum are such that it is almost impossible to penetrate them.

Of the 11,000 skulls examined for deformities, only 3,000 were in a broken condition, so that the antra could be examined, making 6,000 antra in all. Of this number 1,274, or about 21 per cent, had abscessed molar teeth. Of this number 76, or about 6 per cent, extended into and apparently discharged into the antrum. As specialists were unknown among the people whose skulls were examined, a larger percentage of abscessed cavities would be found than at present. Septa were found in 963 cases. These ranged all the way from a simple ridge running along the floor to a partition extending two-thirds the

height of the cavity. Again, several septa occurred in all directions, which gave the appearance of ethmoidal cells extending throughout the entire cavity.

In the treatment of 367 cases of pulpless teeth, in connection with the superior molars, in the past twenty-two years, only three cases of diseased antrum were noticed, making less than three per cent of diseased antrum.

M. H. Fletcher found in 224 cases of pulpless molar teeth, only one case of pus in the antrum. Antral difficulties are hence very rarely connected with the teeth. Most cases of diseased antrum seek the rhinologist because most are connected with

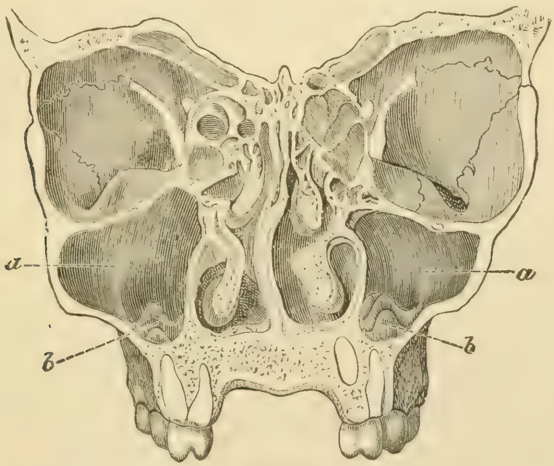

Fig. 73.

the nasal lesion, hence, the dental surgeon sees but a small percentage of actual cases. Disease of the antrum is very rarely due to diseases of the teeth. Like diseases of the mucous membrane of the nose, disease of the mucous membrane of the antra is to a great extent the result of—first, a very abnormal development of the osseous system, and, second, of improper tonicity of the nervous system acting upon a badly developed mucous membrane.

Disease of the antrum, in my experience, is most often observed in persons who have been exposed to cold weather, and that both sides are more or less affected. This was a com-

mon occurrence with epidemic la grippe. If only one side is involved, the other frequently is or has been at a previous time. In the large number of skulls examined, the floor of the antrum was found to be nearly on a level with the line of the alveolar process as far as the anterior roots of the first molar. It then curves upward and forward, terminating at a point above the apex of the root of the cuspid tooth. That being the case, a drill passed through the alveoli of the first and second bicuspid would reach a point quite a distance above the floor of the antrum. From what has been said in regard to the shape and location of the antrum, it will be seen that the lowest and safest locality to puncture the antrum, is just between the roots of the first permanent molar and the root of the second bicuspid. The opening should be made with a drill directed backward and inward. This part is nearly always on a level with the floor of the antrum, and the outer wall is very thin at that point. The patient should be requested to lie first upon the back and then upon the face. Should there be any septa the fluid will in this way be easily drained.

M. H. Fletcher,[2] of Cincinnati, has said with equal truth and clearness, in a paper read before the Section on Oral and Dental Surgery of the American Medical Association, June 1, 1893:

"The summing up or rationale, then, of the evidence herewith seems to be, first, that the anatomical relations between the teeth and the antrum are not generally understood, since the sections here shown give evidence of much more cancellous bone than is usually considered to exist.

"Second. Small septa are present in a large per cent of cases, and these septa or ridges have no direct relation to the position of the teeth.

"Third. Statistics seem to show that a very small per cent of abscessed teeth have any connection whatever with the antrum; this per cent probably not being over seven to ten.

"Fourth. The evidence seems to indicate that the protrusion of the teeth into the cavity is very largely the exception instead of the rule, and that if they do protrude, it is not evi-

[2] Journal of the American Medical Association, 1893.

dence that an alveolar abscess would break there, since these tubercles are usually formed of dense, hard bone.

"Fifth. A number of cases have been found where there is a perforation of the bone by the apices of the teeth and no protrusion; but that these apices are simply covered with mucous membrane, thereby the teeth may be affected by inflammation of the antrum, causing their death and loss or a continuance of the trouble in the antrum by their presence in consequence of this special feature of the anatomy, and that pulpless and inflamed teeth are thought to be the usual cause of antral trouble, where the reverse is often probably the case.

"Sixth. That seemingly the best place to perforate the antrum of Highmore for pus, is between the apices of the second bicuspid and first molar."

"Since writing this paper, Dr. Fletcher examined an additional 400 skulls, and finds the figures changed in regard to the per cent of abscessed molars which are connected with the antrum. In 500 skulls (making 1,000 antra) he found 252 upper molars abscessed, making twenty-five per cent of antra which have abscesses in this locality, or every fourth antrum. This per cent is probably smaller than it should be, since many teeth were lost and the alveolar process absorbed away, and undoubtedly some of these lost teeth have been abscessed. Out of these 252 possible cases, perforation into the antrum was found only twelve times; thus showing over four and one-half per cent, or about one in every twenty-one of the abscessed teeth in this locality, which are connected with the antrum."

CHAPTER XIX.

DEVELOPMENTAL NEUROSES OF THE EYE.

In the typical human infant the eyes are larger than in the adult. In this last particular the human infant resembles the lemurs and thus retains an embryonic tendency which, as elsewhere shown, may remain unchecked and result in unusually large orbits, or the orbits may pass through this lemurian stage to reach and even exceed the anthropoid in smallness and closeness together.

The eye, according to Lee Wallace Dean,[1] during its development, passes, just as the brain does, through stages which resemble and correspond to the eyes of lower animals. If, owing to an affection of its governing center, its development is interfered with or stopped, the eyes correspond more or less to those of the lower animals, as in persistent hyaloid, colobomata, microphthalmia, etc. Neither the degenerate human brain nor the undeveloped eye resemble exactly the brain or eye of the lower animal. While, as I have elsewhere[2] shown, there is a conflict as to the primitive type of the vertebrate between morphologists represented by Howard Ayres (who claims the eyes were derived from the median eye of the ascidian lancelet) and Semper (who is of the opinion that the existing vertebrates' eyes represent the paired eyes of a hypothetical annelid precursor), still both opinions are reconcilable through study of the ascidian and lancelet eye collated with cyclopian and triophthalmic (three-eyed) degeneracies in man, the human eye and the third eye of reptiles, like the hatteria of New Zealand. The eye of the ascidian tadpole agrees fundamentally with the type of eye peculiar to the vertebrates in that the retina is derived from the wall of the brain. On this account it is called a myolonic eye. In the typical invertebrate eye, on the contrary, the retinal cells are differentiated from the external ectoderm.

[1] Ophthalmic Record, Sept., 1900.

[2] Degeneracy, Op. Cit.

The ascidian eye differs essentially from the paired eyes of the craniate (skulled) vertebrates in that the lens as well as the retina is derived from the wall of the brain. The lens of the lateral eye of the vertebrates is derived by an invagination of the extoderm, which meets and fits in the retinal cup at the end of the optic vesicle. The ascidian eye, however, agrees as to lens origin with the parietal or pineal eye of the lizard, in which the lens is likewise derived from cells which form part of the wall of the cerebral outgrowth that gives rise to the pineal body.

The pineal body is a remarkable rudimentary structure whose constant presence in all groups of vertebrates forms such an eminently characteristic median outgrowth from the dorsal wall of the brain (thalamencephalon), the distal extremity of which dilates into a vesicle and becomes separated from the proximal portion. The distal vesicle becomes entirely constricted off from the primary epiphysial (pineal) outgrowth of the brain and the parietal nerve does not represent the primitive connection of the pineal eye with the roof of the brain but arises quite independently of the proximal portion of the epiphysis.

The remote ancestors of the vertebrates possessed a median unpaired myolonic eye which was subsequently replaced in function by the evolution of the paired eyes. The cyclopic conditions occur very frequently among human monstrosities, much more frequently than among animals. Hannover claims this is due to the fact that human monstrosities are much more frequently recorded. Of the 120 cases of human cyclopia, 56 presented other evidences of degeneracy than cyclopic conditions and 60 had neuropathies or other taint in the ancestry. According to Dareste the production of a single eye, the changes in the structure of the mouth, the atrophy and abnormal situation of the olfactory apparatus and of the vesicle of the hemispheres all result from an arrest of development. The determining influences must be exerted very early in the life history of the embryo.

According to Hannover, coincidently occurs hydrocephalus and harelip, imperfect genital development and allied arrests of development. J. R. Folsom, of Cecil, Georgia, has reported a female born alive to a negro multipara, which died two hours

after birth. The eye was centrally located in the forehead on a line with the nose. The brow was a complete arch, as was the upper eyelid. The lower lid had a mark midway indicating an attempt at division. The nasal bones were wanting. The soft part of the nose destitute of the orifice hung over the mouth, which was completely covered. The chin was recedent. In a case reported by C. Phisalix, the nose was wanting. Its place in the median line was occupied by a single eye; on the horizontal diameter were two pupils separated by a narrow space. Landolt, discussing a case reported by Valude, claims that while in cyclopic eyes all the parts may be doubled or unite in every degree, there is never a single lens or double vitreous. Bock

Fig. 74

and others, however, describe cases in which the eye had not been formed by the conglomeration of two separately developed eyes, but is a single developed eye; the other being wanting entirely. Bruce reports a cyclops in which there was a single socket for the eye, of a lozenge-shape, situated in the lower middle of the forehead. The socket was furnished with two pairs of eyelids, upper and lower. The eye was found to consist of two rudimentary retinæ apparently springing from a single optic vesicle. The nose was represented by a short process attached to the forehead, above the median eye. The cyclops illustrated (Fig. 74), was born to a seventeen-year-old neuropathic primi-

para after a protracted labor. The child was living, but killed by pressure on the funis. The mouth contained an ivory tusk-like tooth at each corner. There was mane-like hair around the neck. Cyclopia is very frequently associated with the absence of both the internal and external ear and with synotia (joined ears). In the triophthalmic cases the three eyes are usually separate; two occupying the usual position while the third is situated as illustrated in the case cited. Ninety families of degenerates, averaging eleven children each, had five cases of cyclopia.

Degeneracy which affects so deeply the development of the eye naturally tends to evince itself in other anomalous state in the organ. As excessive asymmetry of the body is one of the most noticeable of the stigmata of degeneracy it is not astonishing to find that this asymmetry expresses itself both in the position as well as in the size and structure of the eye. As Kiernan pointed out twenty-three years[3] ago, asymmetrical irides are exceedingly frequent in the types of insanity due to hereditary defect. This observation has since been confirmed by Féré,[4] not only as to the insane but as to other classes of degenerates. The conditions of the eye known as microphthalmia (small eye), macrophthalmia (big eyes) and anophthalmia (absence of eyes) are found quite frequently in degenerate families. Corectopia (displacement of the pupil so that it is not in the center of the iris) often exists. Coloboma (eye fissure) is also not infrequent among degenerates. These vary greatly in situation and general results. The iris is sometimes completely absent on one or both sides (aniridia). Beside these anomalies, diseased conditions like retinitis pigmentosa, congenital cataract and the macular degeneracy (reported by C. P. Pinckard[5]) are far from infrequent expressions of degenerate taint of the eye. The organ in this particular obeys the general law that degeneracy may show itself in the minute change resulting in disturbances of functions or in that producing disease or finally atavism. The defects of the eye requiring glasses are

[3] Journal of Nervous and Mental Disease, 1878.

[4] La Famille Nervopathique.

[5] Medicine, 1898.

exceedingly frequent in degenerates and aggravate their morbidity.

The following cases reported by L. W. Dean,[6] are of interest here since they demonstrate two marked deformities of arrest of development of the upper and lower jaws:

Case XIV. Lillie L. (Fig. 75). Female, age 14. Patient's people are exceedingly poor and so ignorant as to make it impossible to get any reliable family history. There are four sisters and three brothers, all poor and ignorant. The patient is idiotic. She has a retreating forehead, and exceedingly crooked

Fig. 75.

nose, a very long neck and an exceedingly small, retrusive jaw, the lower incisors striking at least one-half inch behind the upper. The teeth are exceedingly irregular. The two left upper incisors are large, the two others very small. Of the lower incisors, the two central ones are like mice teeth, pointed and sharp. They are separated at their bases, but come together at their tops at an acute angle. The other two are conical and lie each parallel to its neighbor. Examination of eyes reveals V—fingers in ½ M. Eyes small. Nystagmus. Fundi apparently normal. Diagnosis, microphthalmus.

[6] Op. Cit.

Case XV. Ida C. (Fig. 76). Female, age 17. Father is deaf. Could obtain no history of degenerate stigmata in mother. Has four sisters living, nine dead. Has four brothers living and one dead. Had to depend on patient for family history. The patient is exceedingly dull. It is impossible for her to learn. She has jaws that, at the junction of the premaxillary and max-

Fig. 76.

illary bones, present a well marked angle. Her teeth are conical. The incisors are sharp and pointed; are like mice teeth. The ears are small and placed high up on the head; she is almost a typical degenerate, both physically and mentally. Examination of the eyes reveals V—cannot count fingers, but sees large objects.

CHAPTER XX.

DEVELOPMENTAL NEUROSES OF THE BONES OF THE EAR.

Aural affections are frequently a result of degeneracy, exhibiting itself under the various forms of deformity implicating the auditory apparatus. Thus total absence of the external ear, as well as embryonic internal ear, occurs. The mere fact of the exceedingly primitive structure of the internal auditory mechanism necessitates abnormal or defective hearing power. To this many cases of congenital deaf-mutism owe their origin, inasmuch as the auditory mechanism is not in a condition to appreciate sound. Even though the individual may not have been born deaf, deaf-mutism from inability to appreciate sound occurs and the whole auditory apparatus subsequently degenerates. Sometimes a mental taint superadded aggravates the case. The absence of the external ears and even closure of the Eustachian tube may occur without deafness.[1]

Stigmata of the bones of the ear occasionally take place. Taking into consideration the complicated structure of which the bone and sundry parts of the ear are composed, lesions of the ear must be attributed to such deformities. In an examination of 1,935 persons, taken as they come, deformities of the jaws were observed (Table XVIII).

Of 143 cases of congenital deaf mutes, 93 per cent exhibited deformities of the head, face, jaws and teeth.

[1] Gould Anomalies, page 261.

CHAPTER XXI.

DEVELOPMENTAL NEUROSES OF JAWS OF THE SEEMINGLY NORMAL.

The mouths of 1,000 school children over twelve years of age and 1,000 adults, patients and friends, were examined with the following results: (Table XIX). There were fifteen per cent more deformities in adults than in children. This is accounted for in two ways: (1) That as people grow older slight irregularities of the teeth may become sometimes more prominent, owing to movement and permanent arrangement of the teeth later in life. (2) Some of those examined are patients who presented deformities that alarmed them. The percentage of deformities, however, compares favorably with the percentage of deformities of the face. Taken as a whole they give an approximate idea of the percentage of deformities in this community at least. The facial bones may become excessively developed or arrested while the jaws remain normal. The jaws may be deformed and the face remain apparently normal. The percentage is from twenty-five to thirty-three per cent less than found in institutions for defectives.

CHAPTER XXII.

DEVELOPMENTAL NEUROSES OF THE MAXILLARY BONES.

Excessive growth of bone-tissue is frequently seen in connection with the superior and inferior maxillæ. It may be a natural growth or the result of disease. If the jaw be naturally large, it will develop gradually and will not attain full size before the age of from twenty-six to thirty-six years. The size of the jaw corresponds quite closely to the size of the head, other things being equal, the large head containing the large jaw. Occasionally, however, there is a very small jaw in a very large head and vice versa. The upper jaw is more subject to morbid influences than the lower jaw, because of its connection with the bones of the head. The lower jaw rarely exceeds the average size. Constant use may increase the size of the jaws, as in acrobats, especially those who use the jaws in various feats, like "the man with the iron jaw." Jaws of tobacco-chewers, singers, public speakers and of the early races who lived upon corn, shell, roots, etc., show that the jaws may be favored in size development by use.

Enlargement of the jaw-bones occasionally causes dental irregularities. This may occur in either jaw, but generally in the upper. It may be due to hypertrophy on the one hand, or hyperplasia upon the other, to osteitis, periostitis, continued irritation drawing blood to the part, in some cases to disease of the antrum and nasal fossæ, producing the same result. Disease of the antrum may cause either periosteal or osteal enlargements. Hereditary syphilis has an especial predilection for the bones, particularly at the junction of epiphysis and diaphysis. Growth of the teeth does not proportionately increase, hence consequent disproportion between the teeth and jaws necessarily produces deformity. The forms of irregularities of the teeth that co-exist with crowded arches are not seen in enlarged jaws. Rachitis in children, whether due to syphilis or not, causes hypertrophy

and hyperplasia of the jaws. The hypertrophy and hyperplasia may be localized in some portion of the jaw, causing it to be unevenly developed. As illustrative of the interesting character of some of these conditions described, I take the liberty to present a few cases which have come under my notice.

Case 1[1]. Arrest of development. Girl aged ten years. Father and mother have well developed jaws. Consumption on father's side; cancer on mother's side. Child scrofulous, with small bones, especially the maxillæ, which are unusually small. When first seen the teeth of both jaws (permanent first molars and incisors, temporary cuspids and molars) are in a very crowded condition. The teeth are normal in size. With such unusually small jaws and the teeth at this age being very crowded, marked V or saddle-shaped arches were prophesied. Four years later the jaws were arrested in their development and a marked V-shaped arch was produced.

Case 2. Arrest of development. Girl aged sixteen years. When quite young had a severe attack of scarlet fever and the arrest of the development of the bony frame-work resulted. The jaws were unusually small and the teeth are crowded to such an extent that the cuspids remain outside the arch.

Case 3. Enlargement of the superior maxilla. A fourteen-year-old boy was sent to me for an opinion in regard to teeth which were found of the normal size. Spaces existed between all the teeth as far back as the first permanent molars. The bicuspids were not fully developed, but were through the gum sufficiently to notice their position in connection with the other teeth. The spaces were not uniform, those between the incisors being the largest. The widest space was between the central incisors; the incisors of the lower jaw coming in contact with the mucous membrane of the mouth posterior to the superior incisors.

Case 4. Hypertrophy of the jaw. A nineteen-year-old patient came under treatment in June, 1887. When fourteen years he received a blow upon the side of the jaw. He is scrofulous. The blow produced a low form of inflammation and hypertrophy of the bone supervened. The teeth of that

[1] This case was noticed in the second edition, 1890.

side of the jaw were carried laterally and spaces existed between the bicuspids and molars.

Case 5. Antrum disease. German-American boy aged seven years. Scrofulous. Quite a deformity was noticed upon the left side of the face, produced by the bulging of the antral wall. Hypertrophy of the alveolar process existed. The temporary teeth on the left side of the upper jaw extended beyond those of the lower jaw. Upon opening into the antrum a thick, ropy fluid exuded. After three months' treatment there was no improvement.

The superior maxilla is influenced to a greater degree by the various causes of jaw deformities than the inferior. The bones of the upper jaw are in direct contact with the other bones of the body, while the lower jaw develops independently and is only attached at its remote extremities by articulation. The body of the bone is free to develop or to remain dwarfed, depending wholly upon its nerve and blood-supply for its nourishment. There are indications that the superior is gradually diminishing in size. The inferior maxilla, although under the same influences, has a powerful factor to aid preservation, viz., motion and exercise. The question naturally presents itself as to what extent certain properties of the jaws, influenced by habit (use), may be transmitted. The tissues of the body, especially those of the osseous and muscular systems, possess a certain degree of plasticity, by which they are enabled to change their weight or shape. This quality depends upon the use of muscles and bones. Among vertebrates a close relation exists between the muscles and the bones upon which they are inserted. The union is made up of tendons, which are prolongations of the muscles to the periosteum and the periosteum is attached to the bones. Powerful muscles and large bones are always associated, exercise developing them both simultaneously. As outward changes occur in the life of human beings or animals, adjustment to environment tends to alter the physical characteristics. These changes often occur through such gradual modifications that from one generation to another but little marked difference is noticed, but the structure, in the course of a number of generations, will so change that a new species will be devel-

oped. Any animal domesticated from a wild life shows this change. The negro imported from Africa will, after several generations, have a less prominent jawbone, more prominent frontal bone. The changes, however, are more gradual in the white races, after intermarriage, than with negro cross-breeds. No part of the body demonstrates these changes so forcibly as the superior or inferior maxilla. The extremities must be measured and weighed to compare the two halves of the body. The changes in the shape of head and jaws are not confined to one race nor to past generations and are continually progressing.

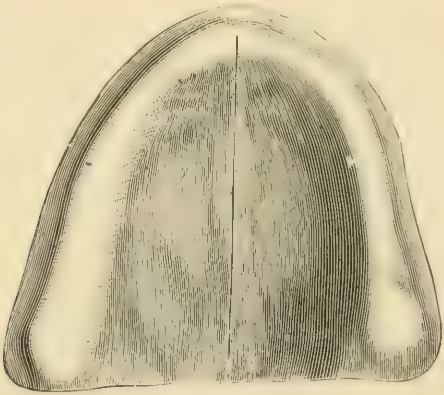

Fig. 77.

Asymmetry of the lateral halves of the maxillary bones exists in the present era of the human race and prevails to a greater extent among neurotics and degenerates and among the offspring of mixed races. Each lateral half of the body develops independently of the other. The jaws, like other members, are influenced by the independent growth of the two halves, so that each has its own peculiarities. Asymmetry, therefore, is caused from an inharmonious lateral development of the parts. The superior and inferior maxillary bones, growing independently of each other, may be subjected to peculiar conditions of environment so that the result of their development may be asymmetry of the jaws. Extreme asymmetry of the lateral halves of the human body is frequently observed.

Exact measurements of the maxillary bones will show lack of harmony in the lateral halves; to be, observed in weight, shape and size. The difference is generally not sufficient to affect the contour of the face, but causes faulty articulation to the teeth upon that side of the face. This is generally due to the number of teeth that remain in the jaw late in life. Thus a molar or bicuspid may never have developed upon one side, while the full number are in position upon the other side, or they may have been extracted upon one side, while the full number remain upon the other. Again, owing to an irregularity of the teeth in the anterior part of the mouth the posterior teeth,

Fig. 78.

although all are present, may have moved forward. In any of these conditions the alveolar process and jaw would become shorter upon one side than upon the other, owing to absorption of the alveolar process. The deformities of either lateral side of the superior maxilla are not necessarily like those of the inferior. Excessive growth or arrested development appear upon both sides of the jaws, sometimes on the right and again upon the left. Examinations of these deformities can be made only when the second teeth have been extracted and the alveolar process has been absorbed.

Fig. 77 shows the superior maxilla after absorption has taken place. If a line be drawn through the jaw at the median line, it

will be seen that the left half is fully developed, while the right half is contracted at the bicuspid region. The following statistics show the deformities in the contour of jaws modeled by Dr. L. P. Haskell, of Chicago:

UPPER JAW.

Total number examined	298
Total number normal	137
Total number abnormal, right side	73
Total number abnormal, left side	88

Fig. 78 illustrates the inferior maxilla after the teeth have been extracted and absorption of the alveolar process has taken place. By drawing a line through the center of the lower jaw at the median line a wider space may be seen to exist between the line and the left side than on the other side.

LOWER JAW.

Total number examined	154
Total number normal	54
Total number abnormal, right side	12
Total number abnormal, left side	88

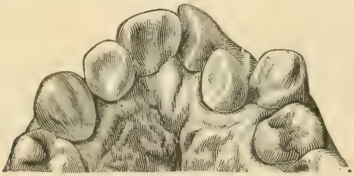

Fig. 79.

Although no two cases of irregularities of the teeth are exactly alike, there is a general similarity of shape and outline of alveolar process and jaw, owing to similar environments during eruption of the teeth. Upon the hypothesis that the two halves of the superior maxilla are developed in proportion to the excess of food masticated on one side or the other, depending upon right and left handedness of the individual, it seemed probable the case illustrated is that of a left-handed person, as the left side of the jaw is larger. But it appears that this side is normal in size and the right is deficient in development. On examining carefully the contour of patient's teeth but few arches are found uniform. While one side may be normal the other will be depressed. Fig. 79 shows such a deformity. This

cut is taken from a model of an extreme case of irregularly-shaped jaw. It represents a perfect semi-V-shaped arch. (I find in my collection of models thirty-eight of this variety of deformity, twenty-four of which are on the right side and fourteen on the left.) Most of these irregularities are not quite as depressed at the cuspid region as the cut indicates. No two are exactly alike as regards the position of the teeth and yet the similarity is so complete that a non-professional man would immediately take notice of it. The asymmetry of the jaw illustrated in Fig. 77 is probably caused by the peculiar arrangement of the permanent teeth in the arch, since the deformity is not apparent during the first set of teeth, the alveolar process and maxillary bones being molded into this peculiar shape thereby. Since but few people are left-handed, this percentage is very large, showing twenty-four out of thirty-eight cases with deficiencies on the right side, when we might look for normal or excessive development on that side. The cause of this irregularity is of local origin, viz., too early extraction of the temporary teeth upon the affected side, thus showing that one side is as liable to be affected as the other. The mechanism of this irregularity will be found under the head of local causes.

The asymmetry upon the lower jaw may be traced to two causes:

First: The full number of teeth retained upon the long side If the third molars should develop on one side only, the jaws on that side would expand by the crowded condition of the teeth and extend farther from the median line than otherwise. The loss of the third molars by extraction or non-development would prevent the other side from increasing to the natural size.

Second: The relation of the upper teeth to the lower teeth. The articulation of the inferior maxilla with the cranium is so remote and the contour of the two bones so unlike, that uniformity of bone-structure cannot be looked for. When the complexity of the development of bone-tissues, first of the maxillary bone, then of the alveolar process and lastly of the two sets of teeth, is remembered, it is a wonder that harmony ever prevails.

Haskell's deformity.[2] On examining models of the superior maxilla after absorption of the alveolar process has taken place, it is observed that in the cuspid and bicuspid region, high above the alveolar border, a marked depression exists on either side. Fig. 80 shows a base plate which has been formed over such a model. The plate is more depressed at the left than at the right side. This peculiar deformity is familiar to the operator who arranges teeth and waxes up plates for the purpose of restoring the contour of the face. Upon closer inspection of the model it will be seen that there is asymmetry of the lateral halves of the maxillary bones. With Haskell's assistance, I examined 298 models, finding 268 out of the number with marked depres-

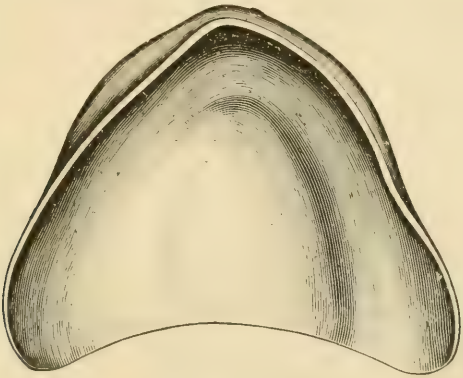

Fig. 80.

sion on the left side, and twenty-four with the depression on the right side. Only six cases on both sides were alike. This depression is due to an asymmetry of the maxillary bones. An asymmetry so slight as to be hardly recognizable may produce it. As the body has passed from left-handedness to right-handedness, the left side being the weaker as least used a large proportion of cases of this depression are necessarily found on the left side.

For many years Haskell has observed a marked difference between the right and left sides of models of both the upper

[2] I have named this deformity "Haskell's Deformity" for the reason that Dr. Haskell first called the attention of the profession to this peculiar condition of the maxillary bones years ago.

and lower jaws, but more especially noticeable in the upper jaw. It is not so apparent upon a casual glance at the model, for it is not so much in the alveolar process as in the maxillary bones. But a plate swaged upon a model from an impression taken high over the region of the cuspids (as ought always to be done) shows at once the depression of the left side, which occurs, to a greater or less extent, in ninety-five per cent of cases. The difference becomes apparent in arranging artificial teeth. Experienced dentists will have noted that greater length of teeth and gums is required upon the left side than upon the right. How often it is seen that the left side of the lip rises higher in talking and laughing than the right side. The difference in the two sides of the lower jaw does not occur as often, but is apparent in the divergence of the left side from a line drawn through the center of the model so that the posterior teeth on that side must be set farther in upon the plate.

My own observation of models and patients has indicated that the majority of deformities of this nature exist on the left side. Man, like some other animals, usually moves the lower jaw from right to left in mastication. (As people are sometimes left-handed, so it is possible to find cases where the jaws moved from left to right). The constant friction of the lower teeth against the upper, and the crowding of the teeth into place while erupting, carries the superior arch with the alveolar process toward the right or left. By pressing the index finger over the cuspid and bicuspid roots, above the alveolar process it is shown that the majority of mouths contain teeth with their roots standing out more prominently upon the right side than upon the left side. The right superior dental arch, like the arch of a bridge, resists such inward force because of the lateral contact of its teeth. On the contrary, the left superior dental arch may thus be carried slightly forward. The limited lateral motion during occlusion prevents the teeth and alveolar process from being carried farther. The cuspid tooth may be prevented from being carried in as far as it otherwise would be owing to the lateral motion of the lower jaw to the left. The alveolar process is thus carried beyond the border of the maxillary bones. After the teeth have been removed, absorption of the alveolar process

occurs, leaving only the alveolar ridge. The ridge then overhangs the maxillary bone, thus producing a depression upon the left side. This is the reason that in arranging artificial dentures in many cases the teeth are carried over the alveolar border farther than upon the right side to obtain proper articulation with the natural teeth upon the lower jaw.

On examining the model upon which the base-plate was formed, it will be seen that both the right and left alveolar borders are symmetrical. The alveolar border in most cases indicates the contour of the teeth when in position.

A case seen with G. Frank Lydston is a marked illustration of congenital maxillary asymmetry. The man is thirty years of age. The inferior maxillary is small and the chin pointed and narrow. There is a difference of one-half an inch in the length of the rami, the left ramus being the shortest. The difference is sufficient, when the face is smoothly shaven, to produce a noticeable deformity. The teeth are irregular in both jaws, the irregularity, however, being most marked in the superior jaw. The cranium partakes of the asymmetry and the frontal suture is plainly marked. Numerous irregularities of the surface of the skull are observable. The larynx is displaced at least one-half an inch from the median line toward the left side. There is no history of injury and a point of interest in this case is the fact that the asymmetrical and small jaw is a family characteristic and has been noticed for several generations. The jaw, in this case, resembles the father's, while the arrangement of the teeth is similar to that of the mother. The upper portion of the body appears to have been developed in two lateral halves and when brought together the left side of the body was higher than the right side. The cranium and maxillary bones show this deformity quite conspicuously. The teeth, which are comparatively sound, are all present. The left superior maxilla is considerably higher than the right. Occlusion is perfect, thus compensating for the short left ramus.

Another similar case is that of a twenty-year-old woman, who has arrest of development of the upper jaw. The body of the lower jaw is excessively developed. Length of right ramus, 2.25 inches; left, 1.50 inches. The result is that the lower

jaw is thrown to the left the width of the right central incisor tooth. Her father and uncle have a similar deformity.

A seventeen-year-old girl came for treatment September 14th, 1888. She had quite a prominence upon the right side of the lower jaw and another, although not so marked, upon the left upper jaw. The left corner of the mouth was nearly one-quarter of an inch higher than the right. The face was full and had a peculiar expression, owing to the mouth and jaw being at an angle when closed. Upon examination, the left superior maxilla was found one-quarter of an inch higher than the right side. The alveolar process and teeth shared the same irregularity, thus placing the line of the teeth on the same plane as the lips. The body of the inferior maxilla, from the symphysis to the angle, seemed to be longer upon the left side than upon the right. When the jaw closed, the median line of the lower jaw was half an inch to the right of the upper. The lingual cusps of the bicuspids and molars on the right side of the lower jaw occluded with the buccal cusps of the bicuspids and molars of the upper and vice versa upon the left side.

Asymmetry may be due to excessive development of the body of the jaw on one side and arrest of development on the other.

In the two cases described, while the causes and the external appearance of the face are entirely different, the alveolar processes and the occluding surfaces of the teeth are on the same angle, the inclination being in the same direction. This deformity is found in the mouths of patients over forty years of age, where all the teeth have been removed upon the side of one jaw and upon the opposite side of the other, the alveolar processes containing the teeth elongating upon the side where there is no antagonism and throwing the occluding line of the teeth out of position at an angle similar to that above described.

On examining 1,977 idiots (Table XIV) there were found to be 159 with protrusion of the superior maxilla and 92 with protrusion of the inferior maxilla. These deformities do not exist to such an extent among healthy individuals. This inharmonious development of the maxillary bones may extend from the articulation to the incisor teeth. Such deformities are

rarely found in connection with the first set of teeth. When the alveolar process protrudes during the period of the temporary teeth, it is usually caused by thumb-sucking or an arrest of development of the inferior maxilla. Protrusion of the inferior maxilla is the result of the abnormal development of the rami or body of the jaw or an arrest of development of the superior maxilla. As these abnormal conditions usually correct themselves when the temporary teeth are shed, they consequently receive little attention. But when these deformities arise during second dentition the jaws are determined toward false positions, thus endangering the beauty of the face. Occasionally in acro-

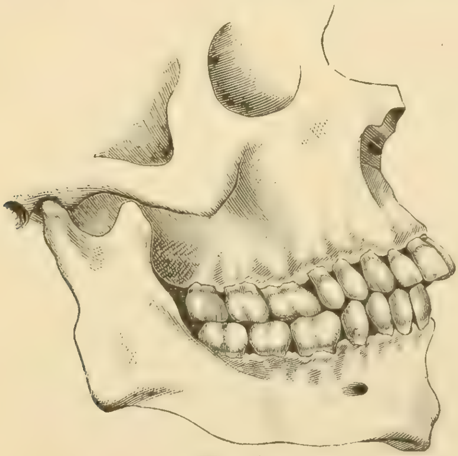

Fig. 81.

megaly and other hypertrophic states occurs excessive growth or there is physiologic hypertrophy of the superior maxilla, when the inferior maxilla is unusually developed. When the teeth are normal in size they appear small in proportion to the abnormally large jaw. They are carried forward with the alveolar process to such a degree that the teeth and lips may protrude. In such cases it appears as if the body or rami of the inferior maxilla were much shorter than is natural, but by close inspection we shall see that the inferior maxilla is normal and quite a space exists between the superior and inferior central incisors. A slight protrusion of the superior teeth is a common defect and is usually accompanied by depression of the face at the root

and alæ of the nose and protrusion of the anterior alveolar process and upper lip. If the maxillary bones as well as the alveolar process be enlarged, the teeth will stand perpendicularly with the alveolar process. If the superior maxillary bones be small, the teeth will protrude from the perpendicular to an angle of 45 degrees. Such a case is illustrated in Fig. 64, page 131 (Kingsley's "Oral Deformities"). This is a deformity frequently met with in practice. A common cause of protrusion of the superior maxilla is illustrated in Fig. 81. The teeth in the upper jaw are fully erupted but are directed downward and forward; the teeth in the lower jaw are in their proper position. Here the rami of the jaw are inharmoniously developed, the

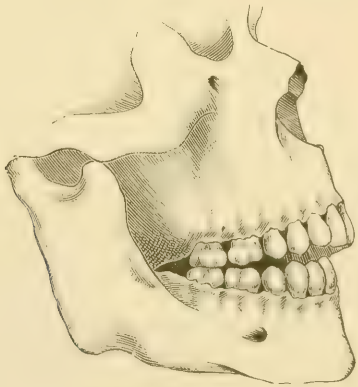

Fig. 82.

rami being so short when the jaws close that the occlusion throws the superior teeth and alveolar process forward. In this case the alveolar process is quite thin, because the arch is high and the teeth, having long slender roots, are easily carried forward. The inferior maxilla is large, the structure dense and hard and the teeth firmly fixed in position in the jaw. When occlusion takes place, the weaker structure (the superior maxilla) is carried forward by the stronger (the lower maxilla), thus forcing the alveolar process forward, producing harmony throughout the articulation. The shortness of the rami of the inferior maxilla, causing improper closing of the jaws, is a feature strongly impressed upon the dentist who undertakes to insert

artificial dentures. The tendency of the lower jaw to force an upper denture out of the mouth, by striking the teeth at an angle instead of perpendicularly, is a marked illustration of the inharmonious development of the jaws. The same difficulty is frequently experienced with the partial lower plate when it presses against the anterior teeth and alveolus, forcing them both forward by improper articulation. The occasional grinding of the surfaces of the artificial molars to produce proper articulation is another illustration of the effects of this inharmonious development.

Fig. 82 illustrates a deformity produced by the before-mentioned cause with very different results. The case is that of a fourteen-year-old boy. Before the eruption of the second molars the articulation was perfect; but as soon as the second molars occluded the jaws were forced open. The rami are so short that when the second molars and the alveolar processes of the superior and inferior maxilla come together a space exists between the central incisors.

Unlike the former case, the superior alveolar process is remarkably well developed and the teeth are firmly fixed in the jaw. The vault of the mouth is quite low. The position of the teeth in the alveolar process is such that when the lower teeth occlude they strike directly on a line with the long axis of the roots, thus preventing the forward movement of the teeth and alveolar process. The inferior maxilla is not well developed, nor has it the power to overcome the resistance and force the superior alveolar process and teeth forward, as exemplified in Fig. 81. When the rami are so short that they do not harmonize with the maxillary bones the movement of the jaws may be likened to the arms of shears; the farther the points are from the center, the greater the distance they have to travel. A slight movement at the center will cause them to move a considerable distance. In a similar manner a slight excessive protrusion of a molar will cause the anterior teeth to become separated. The shorter the rami, the less the harmony between the jaws and teeth; the farther back the protruding molar and the more it projects, the greater the anterior separation of the jaws. The excessive eruption of the second and third molars is very often

due to the persons sleeping with the mouth open; the pressure upon the posterior teeth being removed, the teeth and even the alveolar process will elongate. Not infrequently the mal-occlusion of the teeth is due to the inability to close the jaws on account of the inharmonious development. Occasionally there are mouths in which the molars and bicuspids occlude and there is just enough space between the centrals to admit a thin spatula. January, 1887, a patient was brought for advice whose jaws when closed showed a space of half an inch between the incisors. Such cases are due to arrest of development of the anterior alveolar process, the superior dental arch being too small for the inferior. The pressure of the jaws upon the molar teeth is, in some

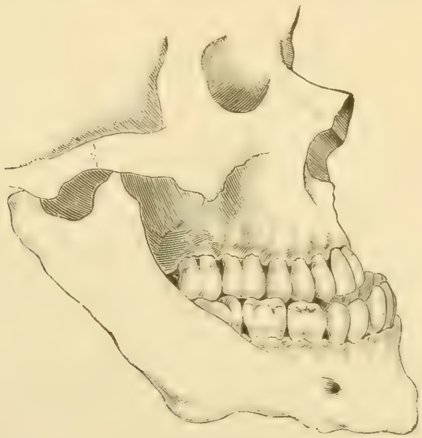

Fig. 83.

instances, so great that normal eruption is impossible. In such cases the molars will protrude through the gum and the superior and inferior processes will occlude when the jaws meet.

Protrusion of the inferior maxilla, since it produces a most repulsive deformity of the face, should be corrected as early in life as possible. When caused by or associated with arrested development of the superior maxilla, it is extremely difficult to restore the features to a natural expression. A case (Fig. 83) came to my notice in 1887, of a commercial traveler from New York, who called for the purpose of having a gold crown reset. There was marked deformity in the jaws, consisting of a depres-

sion at the alæ of the nose and an unusual protrusion of the inferior maxilla. Upon examination, the second molar on the upper jaw and the third molar on the lower jaw were found to be the only teeth that occluded. This was caused by arrest of development of the bones of the face and an excessive length of the rami of the lower jaw. The body was normally developed, but was carried forward by a lengthening of the rami. To add to this deformity, there was marked arrest of development of the bones of the face. There are cases where the lower jaw projects beyond the upper; but on closely examining the deformity another cause is found for this appearance.

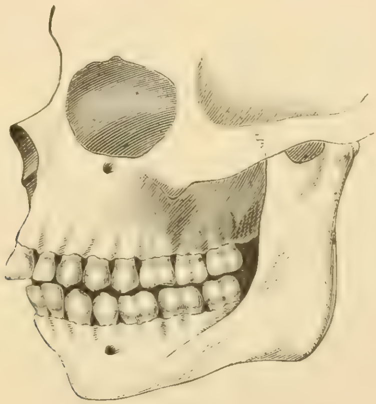

Fig. 84.

A girl fifteen years of age was sent for treatment by a dentist from a neighboring state. He desired me to "force the inferior maxilla back into place." The rami and body of the jaw were apparently normal. The external appearance of the chin and cheeks was in keeping with the outline of the face. The upper lip was much depressed and deep lines extended from the alæ of the nose to the corner of the mouth. The cheek bones were also undeveloped. Upon opening the mouth, arrest of development of the superior maxilla was found. The superior incisors closed inside of the inferior incisors; the first and second bicuspids, first and second molars, were in position, but had crowded forward close to the lateral incisors. The cuspids were quite outside the arch. The superior dental arch had to be forced

out, instead of carrying the inferior maxilla in, which would tend to further complicate the case.

In the case of a young man was found what had been regarded as a "prognathous lower maxilla." This was caused by arrested development of the upper maxilla. Five years had already been spent in trying to reduce the deformity. Had the attempt succeeded the deformity would have been greater than it was. Instead of moving the lower teeth back the upper teeth should have been moved forward. After six months' treatment on this plan the teeth were corrected and the face greatly improved.

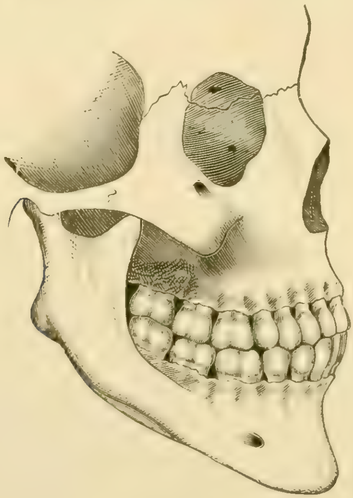

Fig. 85.

In the majority of cases which appear tc result from a protrusion of the lower jaw, the lower maxilla does not project abnormally but the superior maxilla being arrested in its development, gives the protruding appearance to the lower jaw. Before undertaking to correct such a deformity the general contour of the face should be carefully studied.

A peculiar and common deformity of the inferior maxilla (Fig. 84) is that where the body of the jaw is very short. A line dropped perpendicularly and touching the chin at the median line would pass through the bicuspid region of the superior maxilla. A front view of such a deformity has an appearance

as though the lower jaw were absent and a side view throws the nose out prominently while the chin and forehead retreat. The rami of the jaw are larger than the body. The articulation is good, the defect being that the teeth in the incisor region strike quite a distance posterior to the superior incisors. Arrest of development of the lower jaw frequently result when the superior incisors are crowded inward irregularly, or when there is arrest of development of the superior maxilla, the lower incisors coming in contact with them, thus preventing the forward development of the body of the jaw. The anterior portion of the lower jaw remains stationary, while the development is in the posterior direction.

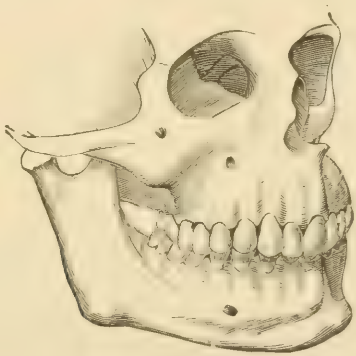

Fig. 86.

Fig. 85 represents jaws such as are frequently seen. The long body and protruding chin, narrow and contracted alveolar process on the lower jaw, a small superior maxilla and thin protruding alveolar process are in keeping with the thin faces and sharp features of the class. The body of the inferior maxilla is small, thin and very delicate; the rami unusually short—just opposite to the one last described. A line drawn parallel with the occluding surfaces of the teeth would meet the angle of the jaw, which in a normal jaw would extend from one to one and a half inches below the line. Naturally slender, delicate muscles and tendons are associated with such bones. In these cases dislocation of the inferior maxilla is liable to occur while yawning or during dental operations, so great is the leverage. In this instance the length of the jaw compensated for the width.

so that in this particular case the teeth are not irregular; although irregularity frequently accompanies this peculiar formation of the jaw. This is particularly the case with the saddle or V-shaped arches on the upper jaw and the saddle-shaped and forward inclination of the molars, bicuspids and cuspid teeth on the lower jaw. The roof of the mouth is also very high and the alveolar process very thin, giving the roots of the teeth but slight support. The same principle of organization and structure is operative in the alveolar process and teeth of the lower jaw.

Fig. 86 represents the jaws of a patient, twenty-six years of age, in whom, on examination, was found a small normal inferior maxilla, well protruded and in harmony with the other

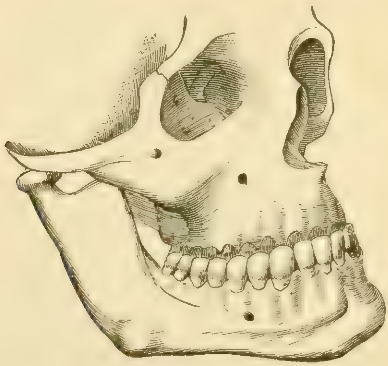

Fig. 87.

features of the face. The superior maxilla and alveolar process were excessively developed, the first molar and anterior teeth describing a much larger circle than the lower. The second molars were the only teeth that articulated properly. The anterior alveolar process had taken on a profile deposition of bone-cells until the teeth impinged upon the gum of the lower jaw, producing absorption and expansion. The upper lip was covered with a mustache which completely hid the deformity. Under such conditions a prominence is observed at the alæ of the nose—the upper lip being drawn over the alveolar process.

Fig. 87 represents a case rarely met with. The body of the inferior maxilla is excessively developed, the extent of the irregularity depending on the degree of development. When only a

slight protrusion exists the incisors strike beyond the superior incisors. In extreme cases only the molars articulate. When the anterior teeth articulate the alveolar process develops so that the teeth extend to the superior alveolar process. The features may be otherwise quite regular. Asymmetry of the jaws often continues to develop until the osseous system has obtained its growth.

Complete absence of the inferior maxilla, as Gould remarks, is much rarer in man than in animals. Nicolas and Prenant have described a case of this in a sheep. Gurlt has observed cases with total or partial absence of the inferior maxilla, agnathes or hemignathes. Simple atrophy of the inferior maxilla occurs in man and the lower animals, but is much less frequent than atrophy of the superior maxilla. Langnebeck reports the case of a young man who had the inferior maxilla so atrophied that in infancy it was impossible for him to take the breast. The patient had nearly complete immobility of the jaws. Boullard reports a facial deformity with deficiency of the condyles of the lower jaw. Maurice has reported a vice of conformation of the lower jaw which rendered lactation impossible. Tomes describes a lower jaw, the development of the left ramus of which had been arrested. Canton describes an arrest of development of the left perpendicular ramus of the lower jaw combined with external malformation. The bull dog seemingly displays inferior maxillary prognathism, but here the deformity is really superior brachygnathism, as he, E. C. Kirk and others have shown, the superior maxilla being arrested in development. As the bull dog here illustrates a degeneracy likewise occurring in man, its value as an understudy in jaw and tooth irregularity is obvious.

CHAPTER XXIII.

DEVELOPMENTAL NEUROSES OF THE VAULT.

Many years ago Langdon Down, in a paper read before the British Odontologic Society, stated with regard to the idiots in the Earlswood Asylum that: "Of the most significant value, however, is the condition of the palate. I have made a very large number of careful measurements of the mouths of the congenitally feeble-minded and of intelligent persons of the same age, with the result of indicating, with some few exceptions, a markedly diminished width between the posterior bicuspids of the two sides. One result, or rather one accompaniment, of this narrowing is the inordinate vaulting of the palate. The palate assumes a roof-like form. The vaulting is not simply apparent from the approximation of the two sides; it is absolute—the line of juncture between the palatal bone occupying a higher plane. Often there is an antero-posterior sulcus corresponding to the line of approximation of the two bones. An appeal to the condition of the mouth is an important aid in determining whether the lesion on which the mental weakness depends is of intra-uterine or post-uterine origin. In the event of the mouth being abnormal it indicates a congenital origin; while if the mouth is well formed and the teeth are in a healthy condition, it would lead to the opinion that the calamity had occurred subsequently to embryonic life."

These conditions, when present in children, were pathognomic of idiocy, according to Langdon Down. Further investigation showed while many idiots and imbeciles possessed low, narrow vaults, many sane people had high vaults and V and saddle-shaped arches. Clay Shaw[1] decided from the results of his researches that while there is no necessary connection between a high palate and a degree of mental capacity of the individual a high palate is invariably associated with narrow pterygoid width and a narrow skull. On examination of Clay Shaw's results it is evident that the intellectual standard he

[1] Journal of Mental Science, July, 1876.

adopted was too limited to admit of his sweeping assertions in regard to mental capacity. Furthermore that the claim anent narrow skull and high palate is a sweeping assumption based on a few selected cases. Examination of the skulls in any moderately sized anthropologic collection will disprove this assertion. Cuylitz,[2] of Belgium, accepting the claim of the connection of high vaulted palates with mental deficiency, asserted in explanation that "the brain tends to develop transversely, but it meets in some cases a resistance in the parietal region which crowds it back. This pressure is transmitted by the zygomatic temporal and malar processes pushing together the alveolar borders of the superior maxillary like a workman's tongs (the approximation of the main branches of which is that of the parietals) brings the ends together; the hinge being represented by the body of the sphenoid and the occipital. This bringing together, therefore, of the alveolar borders or the original palate is only the expression of a cerebral collapse or abnormal effort which in the psychic life reveals itself by degeneracy."

While this explanation is exceedingly ingenious, it is as yet in the earliest stages of a working hypothesis. Idiocy, it should be remembered, is but a bud on the tree of degeneracy and many conditions of checked development found in it are found in other forms of degeneracy as well.

It is not surprising that practices among idiots should have been charged with producing palatal deformities really due to checked development. Ever since Imrie's[3] time, the opinion the "rabbit mouth is due to keeping the thumb in the mouth for hours after going to sleep" has, with various modifications, but without careful analysis, been repeatedly reiterated in parrot-like fashion. The first attempt to corroborate Imrie was that of Thomas Ballard, who, in a paper on the "Constitutional Ill-effects of Fruitless Sucking and the Diagnostic Value of Deformed Jaws in Relation Thereto," read before the British Odontological Society in 1864, claimed that "as in idiots are seen the worst forms of defective growth, so also do they exhibit the most aggravated forms of deformed jaws and teeth; the habit of sucking being retained by them to an advanced age."

[2] Annales Medico-Psychologiques, XVII, 1885.
[3] Op. Cit.

When the size of the vault, especially its antero-posterior diameter, is compared with the thumb, lip, tongue, sugar teat, etc., it seems absurd to suppose for a moment there was any comparison in size between the two or that depression made by any of these could produce uniform width and height throughout the entire length of the vault.

Children commence to suck their fingers soon after birth. As absorption and deposition of bone cells take place faster at this time than at any other in the life of the individual, one would naturally expect to find high, narrow, deformed vaults in connection with the first set of teeth or before the sixth year, but such is not the case. Children with the habit of finger sucking often have very low vaults.

Clouston,[4] a decade ago, attempted study of the palatal stigmata of degeneracy from a very limited standpoint. As he completely ignored all previous results his conclusions, while not undeserving of attention, require critical analysis. He divides vaults into three groups: Typical (or Normal), Neurotic and Deformed. The first has a low but regular wide dome (Fig. 88, No. 1). The second type (Fig. 88, No. 2) is designated as "neurotic" because, according to Clouston, the "deformity of the palate occurs during the brain growth, early in the life, probably in utero." In Clouston's opinion this indicates "bad initial neurotic heredity." The third type (Fig. 88, No. 3) is designated as "deformed."

The conclusions of Clouston, however, need not be discussed at length, since they are largely based on preconceived notions which ignore the researches of comparative anatomists, of alienists of world-wide fame, of embryologists, of ethnologists and of criminal anthropologists. They are quoted here in illustration of the confused contributions on this subject. In a general way, Clouston adopts the theory of Langdon Down in 1871 and Cole in 1881, that "excessive vaulting of the palate is due to arrest of development of the sphenoid bone" and "premature ossification of the suture at the base of the skull." In considering the palate and upper maxillary bone, one must take into account, Clouston remarks, the following considerations, viz.:

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[4] Journal of Mental Science, 1890.

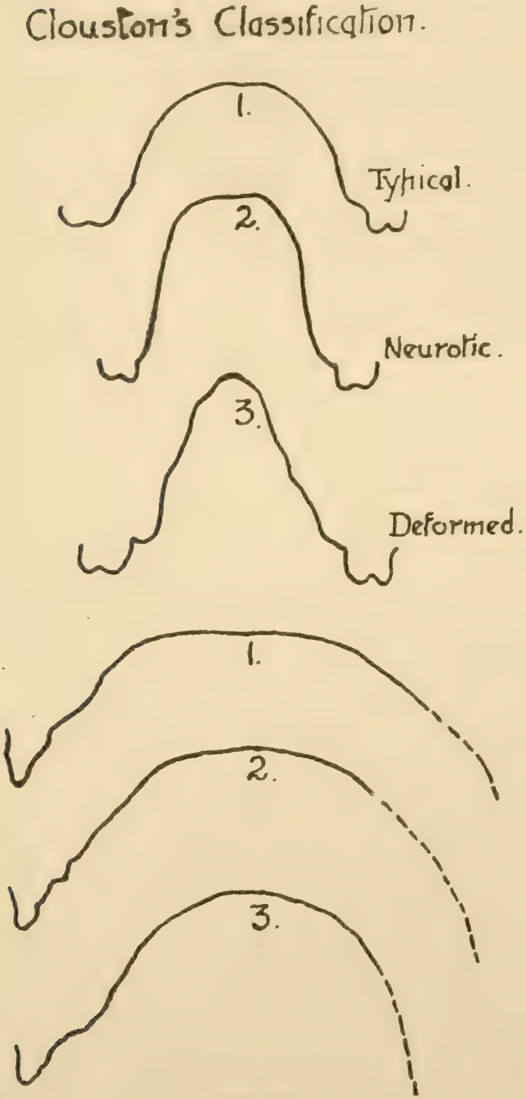

Clouston's Classification.
1.
Typical.
2.
Neurotic.
3.
Deformed.
1.
2.
3.

Fig. 88.

Its relations to the base of the skull in man. This relation is seen to be close and absolute as compared with the lower animals. If a perpendicular line is drawn, marking the most anterior point of the brain, it is seen to fall, in man, through the center of the hard palate, while in the monkey it only just touches its posterior margin. In man it thus has a direct relationship to the brain base and its shape would be dominated by the width of this; while in the monkey it is nearly a part of the alimentary system, having little relationship to the base of the brain at all. No one can compare the two without seeing that its conformation in man will naturally follow any changes that take place during development in the skull-base. If the skull, in its growth, size, shape, dome and base, is absolutely dominated by the brain it contains and on which it depends, then the brain-growth will, in this way, secondarily determine the shape of the upper maxillary bone and palate."

If the intervening space between the base of the brain and the vault were solid, a change in the shape of one might exert influence upon the other. The space occupied by the nares being located between the two, with two strong pillars of the superior maxillary bone upon either side, as a resistance precludes such a theory. The fact that the jaw has become less normal, or that the anterior lobes of the brain have developed and become more prominent, would tend to the belief the roof of the mouth should be less vaulted, or in other words, the base of the skull, which is situated above the vault instead of posterior to it, would occupy much of the space necessary for the anterior and posterior nares, thus crowding down the vault. That any force, produced by the development of the bones at the base of the skull, or early or retarded ossification of suture in that locality, could exert any influence through the vomer is not well taken.

The fact that the vomer does not ossify until puberty, the thinness of the bone after ossification has taken place, and that it is most always crimped or deflected in one direction or another, is evidence that no effect could be produced upon a vault of bone supported by the anterior alveolar process and with a rib or suture extending its entire length, which ossified years before

any changes in the vault were noticed. The ridge and the two vaults, one on either side, often extend anteriorly through the alveolar process nearly or quite to the incisor teeth. No one would claim for a moment that the vomer could exert any influence upon the palate either up or down through the maxillary bone and alveolar process. If the argument were true, the vomer before it could draw up the vault would necessarily have to be drawn taut, but such a condition is rarely seen, although high vaults be numerous.

According to Clouston, "Those palates, where the deformity consists in a ridge down the center antero-posteriorly, seem to show that in them the deformity took place at a later period than in other deformed palates where the nasal septum was getting stronger and kept the center of the palate down, while on each side of it the palate was drawn up, making two vaults, side by side, instead of one."

This is based on an erroneous theory. This deformity in the center of the vault may be present as early as the second year, or at the time of ossification. If the theory were correct, that contraction at the base of the skull, producing pressure through the vomer, causes the high vault, when vomer ossification stops this, what carries up the sides of the vault? In such case the vomer would be perfectly straight, which is not the fact.

Clouston reiterates the claim many times, that "the deformity of the palate (which, of course, must include the jaw) occurs during brain-growth, early in life, probably in utero." This is not a well based hypothesis, since the brain continues to grow until the seventh or eighth year. Moreover, the vault does not change very much in height till after the sixth or eighth year; hence a high vault cannot be said to develop early in life, much less in utero.

Adopting the old, pretty generally exploded medical notion of the pathologic and physiologic importance of temperaments, Dr. Robert S. Ivy[5] views "dental and facial types as part of the morphology of the temperaments."

"The shape of the alveolar arch and the dome of roof of the

[5] American System of Dentistry.

mouth, also the articulation of the teeth, and the manner in which the gum is festooned over each tooth, are all indicative of the several temperaments and present varieties worth attention. (Fig. 89.)

The arch of the bilious temperament, from cuspid to cuspid, is almost flat, the lines backward from these points slightly diverging in an almost straight line. The dome of the mouth is high and almost square. When articulated, the upper central incisors overlap the lower and are closely locked. In general form the teeth are large, the corners tending to squareness and are rather long in proportion to their breadth; in texture they are dense and strong. The proximal surfaces are in close contact two-thirds of the distance from the cutting edge to the neck, rendering the festoon of the gum short and heavy.

The sanguine arch resembles a horseshoe in shape. The dome of the mouth is high and semi-circular. The articulation of the teeth is close and firm and their structure is dense. The masticating surfaces of the teeth in this class frequently bite edge to edge and as age advances they are gradually worn down to the gum unless protected by artificial means. In general form they are well proportioned, length predominating in less degree over breadth, and their outlines are rounded and curved. The distal and mesial surfaces are in contact a little more than half the distance from the cutting edge and the festoon is long and delicate in outline.

The arch of the nervous temperament presents a strong contrast to either of the two preceding and is sometimes spoken of as Gothic from its pointed character. From the central incisors, which often overlap for want of space, the line of remaining teeth continues backward with a slight curve, the greatest prominence being between the cuspid and the first bicuspid. The roof of the mouth partakes of the same curve and angles as the arch. The articulation of the teeth is not close, but long, and the teeth belonging to this temperament are of average density and structure. In shape, length predominates over breadth; the distal corner of the centrals is rounded, giving the whole tooth almost the appearance of a lateral and the cusps and cutting edges are long and fine. The point of contact of

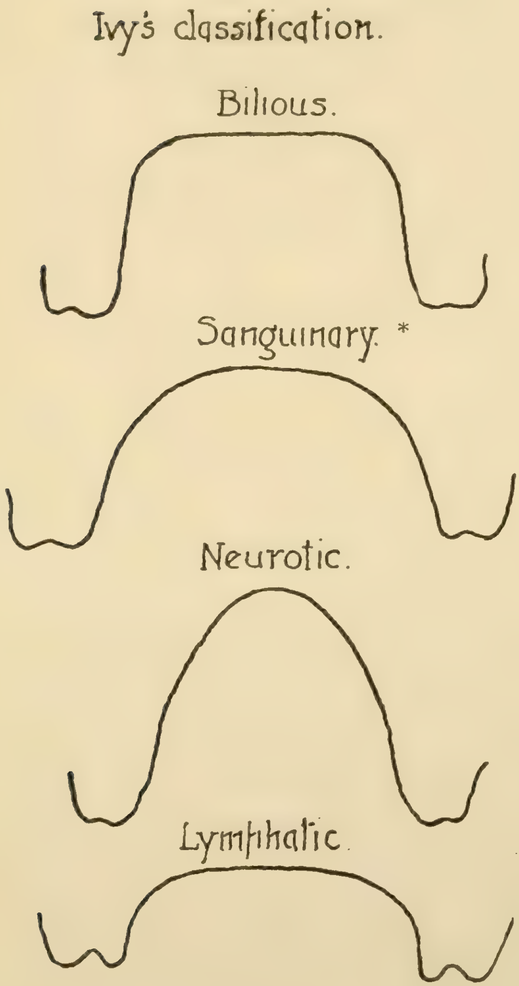


Fig. 89.

* Sanguinary should be sanguine.

the proximal surfaces is near the cutting edge, giving a long, delicate festoon to the gum.

The lymphatic arch is almost semi-circular in its outline and somewhat resembles that of the sanguine temperament. The dome or roof of the mouth is flat and low. The articulation is irregular and the front teeth are apt to protrude. In shape, breadth predominates over length and the normal depressions and elevations are either entirely absent or undefined. The festoon of the gum is thick and indefinite in outline. The lateral on either or both sides is frequently out of line."

The temperament, even accepting the older notions, has nothing to do even with the shape, size and character of the jaws and teeth. The vault, above all, cannot be viewed from such standpoints.

In mouths of the bilious, sanguine, nervous or lymphatic forms of temperaments dental arches in each temperament may measure 2.50 across from the inner surface of one second bicuspid to the inner surface of the other. The dental arch may range down to .96 in width and the antero-posterior diameter from 1.86 to 2.43. The vaults must necessarily range in height and shape to correspond to the width and length of the dental arch.

From hereditary standpoints temperament should not have much to do with the shape of the dental arch. Two individuals, one of nervous, the other of lymphatic, bilious or sanguine temperament, are married; the offspring inherits the jaws of one, the teeth of the other and the temperament of the child is changed. The local condition is such that shape of the jaw may change type of the vault. One child may possess a broad dental arch, but very short, another a very narrow, long dental arch. Hence, classification of the dental arch and vault by temperament is out of the question.

In order to test this question, however, I made a number of examinations along the lines indicated by Ivy, and with the assistance of a medical consultant, as to these temperaments. Under brachycephalic, mesocephalic and dolichocephalic, sixty illustrations (Plates 13 to 22) were made and classified from models of white individuals. The height of vault varies from .31 to .81, with a width from 1 to 1.86; the antero-posterior

ranges from 1.87 to 2.50. The illustrations in outline are as different as it is possible to make them and not produce a deformity. Thus in the antero-posterior direction (Figs. 1 and 7, plates 13 and 15) a brachycephalic with only a difference of .03 in width of head, has its highest part in the vault about the second molar, while another (Fig. 6, plate 13) has its highest at the first and second bicuspids. A mesocephalic (Fig. 6, plate 17) has its highest part midway between the highest part of (Figs. 6 and 7) the brachycephalic.

Viewed from the lateral outline, some brachycephales (Figs. 1, 2 and 6, plate 14) are seen to be pinched or contracted, and this contraction is not uniform upon both sides. Other brachycephales (Figs. 3 and 7, plates 14 and 16) and mesoceophales (Fig. 6, plate 18) are broad. Some cases (Figs. 3 and 7) are not uniform upon both sides, while the teeth do not stand in the same direction; some vertical, others at an angle of 45 degrees.

Brachycephales (Figs. 11 and 12, plate 16), mesocephales (Figs. 1, 3 and 4, plate 18) and dolichocephales (Figs. 4 and 5, plate 21) are sanguine.

Could there be a greater difference possible than is evident in the antero-posterior and lateral illustrations? One (Fig. 12, plate 16) is very high at the middle or about the first permanent molar, while mesocephale (Fig. 4, plate 17) and dolichocephale (Fig. 4, plate 21) are very flat. The soft palate of a dolichophale (Fig. 4, plate 21) extends back considerably farther than mesocephale (Fig. 4).

Some (Figs. 1, 3, 5 and 11) possess graceful curves, but not on the same circle. The teeth also stand at different angles, as in the last group. In the lateral illustrations a (Fig. 4) mesocephale and a (Fig. 5) dolichocephale possess a slight resemblance, although the width and height vary .12 and .31 of an inch, respectively. The lowest vault has the widest jaw, while the highest vault the narrowest. There is a depression at the median line which is quite marked in the antero-posterior illustration (Fig. 4, mesocephalic) that is not in the other. The sides of the arch (Fig. 4) diverge to a greater extent than those in dolichocephale (Fig. 5). No two resemble each other.

The neurotics are said to possess the highest vaults. Brachy-

cephales (Figs. 8, 9 and 10) and mesocephales (Figs. 2, 7 and 10) and dolichocephales (Figs. 1 and 6) alike have a nervo-bilious or neurotic temperament. The extreme highest vault is .75, the extreme lowest .37. In the lateral measurement the extreme narrowest 1 and the extreme widest, 2.50. As far as the shape of the dental arch and teeth are concerned these observations do not correspond with Ivy's in the slightest degree.

To illustrate the wide difference in two individuals of the same temperament take (Figs. 3 and 4) two mesocephales of sanguine temperament. One (Fig. 3) weighs 195 pounds, is six feet two inches, while the other (Fig. 4) weighs 163½ pounds and is five feet eight inches. Both measure seventy-nine lateral index. The two heads are exactly alike. The width of vault in (Fig. 3) is 1, in the other (Fig. 4) 1.37. Height of vault (Fig. 3), .56; (Fig. 4), .50. The smaller man possesses the widest and lowest arch. The shape of the dental arch, the gums and teeth, are wholly unlike. The smaller man has the larger teeth, while the gums are long and pointed. The larger man has short, broad gums.

There were three lymphatic individuals, a brachycephale (Fig. 5, plate 14), a mesocephale (Fig. 9, plate 20) and a dolichocephale (Fig. 3, plate 21). Fig. 5 shows height of vault, .62; Fig. 9, .44; and Fig. 3, .75; while the width of vault is, Fig. 5, 1.25; Fig. 9, 1, and Fig. 3, 1.25.

Some of the illustrations neither resemble Ivy's illustrations nor each other. The same rule holds good in the lymphatic temperament as in the others. There is no uniformity in shape, size or height.

The shape of the vault is said to resemble the shape or contour of the head. Thus a brachycephalic or broad head is said to contain a large, broad jaw with a low vault, while a dolichocephalic or long, narrow, high head should possess a long, narrow jaw with a high vault. To study the relation of the shape of the vault with the contour of the head, numerous models were secured and measurements of the head taken. The shape of the jaws were taken in modeling compound in such a manner that the soft palate could also be outlined. From these impressions, plaster models were obtained, measurements then taken and the

models sawed at the median line. One-half was placed upon paper and an outline obtained. The two halves were then put together and the saw passed through the model laterally between the second bicuspid and first permanent molar. The anterior half was then outlined.

The shape of the head was obtained by the use of a heavy strip of lead carefully moulded to the head in the antero-posterior direction from the nose to the base of the skull, then removed, laid upon paper and outlined. The lateral contour was obtained by moulding the lead over the head just back of the ears. These outlines were reduced by means of the pantagraph to about one-third the natural size. A standard as to skull types is needed.

According to Vogt,[7] "Taking the tables of Welcker as a basis, and assuming the longitudinal diameter of the skull—100, the following results are obtained for the various races: where the mean of the transverse diameter is below 72, they may be termed long heads; where it exceeds 81, short heads; where it varies between 74 and 81, middle heads."

Later craniologists, as already shown, generally assume two fundamental types, the dolichocephalous or long horizontally, that is, from back to front, and the brachycephalous or approximately round horizontally.

My own results support Keane. Dolichocephaly was found to be exceedingly rare in the white and very infrequent among the negroes. The results are to be found in the appendix.

Examination of the brachycephalic whites shows the first six lateral indexes are 84. The width of the dental arch varies from 2.12 to 2.62; outside second bicuspids, from 1.75 to 2.37; width of vault between second bicuspids from 1 to 1.37; antero-posterior, from 1.87 to 2.37, while the height of the vault varies from .44 to .62. In the mesocephalic, white, the range varies from 2 to 2.50 in width of dental arch; width outside of second bicuspids, from 1.62 to 2.25; width inside second bicuspids from 1 to 1.86; antero-posterior from 2 to 2.37, and height of vault from .31 to .68. Dolichocephalic: The range width of dental arch is from 2 to 2.37; width outside second bicuspids, 1.87 to

[7] Lectures on Man.

2.12; width betwen second bicuspids, from 1.25 to 1.50; antero-posterior from 2.12 to 2.31; height of vault from .62 to .81.

The range of figures in each group is so great and differs so much from each other that no two seem to resemble each other. By comparison of one group with another, it is seen there is very little difference as regards width and length of dental arch and width of vault. There is, however, a difference in height of vault.

The figures in the table of the lateral index do not show the slightest resemblance in width, height or temperament, nor the least agreement in contour of the vault and head. The shape of the vault is said to be influenced by the intellect of the individual; that is, the most intellectual people possess the highest vaults. To test this theory, six brachycephalic (Plates 23 and 24), six mesocephalic (Plates 25 and 26), and six dolichocephalic (Plates 27 and 28), negro waiters in hotels and restaurants, were measured. The whites were bankers, editors, medical men, students, architects, bookkeepers.

By comparing the brachycephalic heads we notice that the highest lateral index in the white individuals is 84, in negro 87. The highest width, outside of first permanent molar, is white, 2.62; colored, 2.87. This seemed to be quite remarkable. The lowest white 2, negro 2.25. In width of vault between second bicuspids, highest white 1.37, negro 1.62; lowest white 1, negro 1.31. Antero-posterior greatest length, white 2.50, negro 2.25. Height of vault, highest white 68, lowest 37, with an average of 54; negro highest 75, lowest 50, with an average of 61.

Mesocephalic—Highest lateral index, white 79, colored 80. Highest width outside first permanent molar, white 2.50, negro 2.81; lowest, white 2, negro 2.12. Width of vault between second bicuspids, highest, white 1.86, colored 1.62; lowest, white 1, negro 1.31. Antero-posterior, highest, white 2.37, nego 2.37; lowest, white 2, negro 2. Height of vault, highest, white .68, negro .62; lowest, white .31, negro .50; average, white .52, negro .60.

Dolichocephalic—Highest lateral index, white 72, negro 70. Greatest width outside first molar, white 2.37, negro 2.50; lowest, white 2, colored 2.12. Width of vault between second

bicuspids, highest, white 1.50, negro 1.75; lowest, white 1.25, colored 1.18.

Antero-posterior—Greatest length, white 2.31, negro 2.37; smallest, white 2.12, negro 2.18. Height of vault, highest, white .81, negro .68; lowest, white .62, negro .56; average, white .74, negro .62.

The negro has the roundest heads, while the width of jaws is larger in white, but in the other divisions, the jaws are more uniform in width. The jaw does not diminish in the negro in width anterior to the first permanent molar as it does in the Caucasic race. The height of vault is much higher in the negro than in the white, with the exception of the dolichocephalic heads, where it is higher in the white. The height of vault, like other measurements, is more uniform in the white. Comparing the figures of the negro with the white people, it will be seen, in the average that the width and antero-posterior measurements of the negro are the largest.

Since the highest vaults in the brachycephalic and mesocephalic heads are found in negroes and in the dolichocephalic among the white, it is evident that intelligence has no relation with the contour of the vault. Comparison can no more be made between the vault and the contour of the heads in negroes than there is in whites.

Mouth breathing has been advanced as a cause of high vaults. This view is till held by dentists and medical men. Mouth-breathing is caused by sleeping with the mouth open, by enlarged tonsils, by adenoid growth, by hypertrophy of the mucous membrane of the nose and turbinated bones and by arrest of development of the bones of the jaw and nose. When the mouth is opened, pressure is said to be produced upon the sides of the jaws and teeth by tension of the buccinator muscle, causing contraction of the sides of the jaw, protrusion of the teeth and elevation of the vault.

The superior maxillary bones are fused at the median line. Their under surfaces have imposed upon them the alveolar processes. The maxillary bones proper are made up of dense, compact tissue and are so arranged as to best resist certain forces. The outer surface of the bone is fortified and supported by the

malar process, which is situated midway between the maxillary process and the canine eminence at the first permanent molar. At the canine eminence is the strong, thick plate of bone extending from the bridge of the nose to the alæ, the mesial portion forming the outer surface of the nasal cavity. The nasal septum is situated at the center of the nares and is attached to the maxillary bone at and along the place of union of the two halves of the maxillary bone. A saw passed through from one canine fossa to the other discloses in the section the strong trilateral pillars of bone which go to make up the outer surfaces of the nasal cavity. These strong pillars of bone are situated just at the point of the location of the permanent cuspids and, together with the nasal septum, form a strong support to the hard palate.

Maxillary bones are for the attachment of muscles and the resistance of force in masticating food. The hard palate does not assume the normal shape until the twelfth year, or after the teeth are all in position. The vault may be high or low, ranging from one inch vertically from the alveolar plane on a transverse line intersecting the alveolar crests between the second bicuspids and first molars down to one-quarter of an inch from the plane. In either case the vault may be normal, since each variety depends upon the shape of the maxillary bones and teeth for its peculiar form.

The alveolar process, consisting of soft, cancellated structure, is solely for the purpose of protecting the germs of the teeth before they have erupted, and for supporting the teeth after they are in place. From the time the teeth make their appearance until they are shed, the alveolar process has developed and been absorbed three times. The alveolar process being solely for protection and support of the teeth, its position and shape must depend upon the location of the teeth. The bone proper is not influenced to any great extent by the movement of the teeth.

The buccinator is a voluntary muscle, penniform in shape. It has its origin and insertion along the body of the jaws, above the alveolar process on the upper and below the alveolar process on the lower jaw. It extends from the first bicuspid anteriorly to the wisdom-tooth posteriorly. The center of the muscle in

one direction is therefore on a line with the grinding surface of the teeth and in a transverse direction at the first permanent molar. Its chief function is to convey and hold the food under the teeth during mastication.

In many cases of contracted arches and high vaults, mouth-breathing does not occur. In many cases of normal arches and vaults it co-exists. Mouth-breathing frequently commences very early in life; contracted jaws, on the other hand, never begin until the seventh or eighth and in most cases the tenth year, except monstrosities or from traumatic causes. These conditions when existing are wholly unlike the usual contracted arches, can

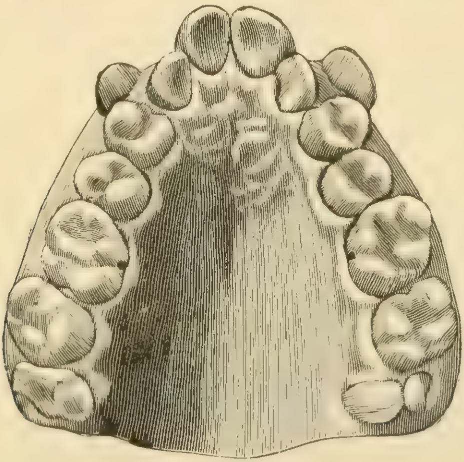


Fig. 90.

be diagnosticated at once, and therefore they should not enter into this discussion. Contracted arches are of two kinds—V (Fig. 90), and saddle-shaped (Fig. 91)—all other varieties being modifications of these two. The cause which produces the one cannot produce the other. There are two-thirds more V and saddle-shaped arches among the low vaults than among the high vaults, taking .58 of an inch as the average. One of these deformities with a high vault is always more marked, since in the high vault the alveolar process is long and thin, with very little resistance, and the teeth are more easily carried in one direction or the other.

In the V-shaped arch, commencing at the first permanent molar, there is a gradual narrowing of the dental arch and alveolar process toward the median line, where the incisors may approximate a V point or may stand in their normal position to each other. Invariably there is protrusion of the teeth and alveolar process, not of the jaw. In the saddle-shaped arch the bicuspids are carried inward and the deformity is invariably situated between the first permanent molar and the cuspid. Unlike the V-shaped variety, the anterior teeth and alveolar process never protrude in this class of deformities. The contracted hard palate is always associated with the V-shaped

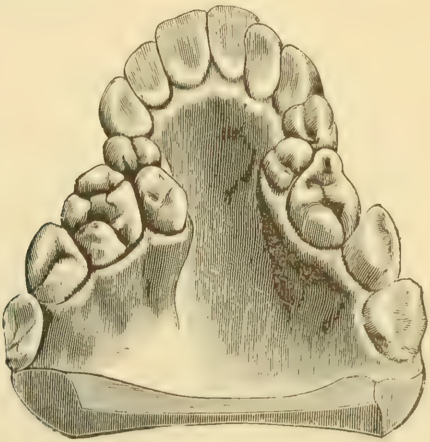


Fig. 91.

variety, in most cases extends backward to the second bicuspid and is never seen with the saddle-shaped variety.

The high vault is never seen in the first set of teeth, nor does it develop until the second set are all in place, which is at the twelfth year. The vault commences to slope slightly from the neck of the incisor until it reaches an imaginary line drawn across the roof of the mouth from the right first bicuspid to the left first bicuspid, here it gradually or abruptly slopes upward until a point is reached which is central and vertical to a line drawn across the jaw from crest to crest between the second bicuspids and first molars. From this point posteriorly to the soft palate the dome is usually nearly level and parallel with the plane of

the alveolar crests of the bicuspids and molars when it gradually slopes and unites with the soft palate. Occasionally there is a slight depression and sometimes a corresponding slight elevation. These are so inconsideratable as to escape notice unless looked for.

In mouth-breathing the lower jaw usually drops only sufficiently for the passage of the same volume of air that would pass through the nasal cavities when in a normal condition. Each of the openings to which is equal to about one-half an inch in transverse area. Old people often sleep with the mouth open and to the fullest extent. These deformities of the jaws and teeth never occur after the eruption of the teeth, about the twelfth to fifteenth year.

On opening the mouth there is a sense of tension of the orbicularis oris, but not of a pressure of the buccinator, no matter how widely the mouth may be open. This muscle being under the control of the will, is always passive, except in the act of blowing or eating. Contraction during sleep is out of the question. As the buccinator muscle extends anteriorly to the first bicuspid only, it cannot be productive of the V-shaped variety of deformity, in which is also found the contracted vault. Therefore the only deformity that might be so produced is the saddle-shaped variety. The orbicularis oris muscle cannot produce the contraction, because when the mouth is open the pressure on the six anterior teeth is backward. Thus the teeth should be carried in the opposite direction from that which must be taken to produce this deformity. The pressure is just as great upon the incisors as upon the cuspids, thus holding them in place. More force is exerted by the orbicularis oris upon the six anterior teeth when the mouth is open than could be exerted by the buccinator muscle, which would tend to hold the anterior teeth in place. Apices of teeth rarely move when pressure is brought to bear upon their crowns for the purpose of regulating them. Teeth having long roots like the cuspids are hence less liable to move than teeth with short roots like the lateral incisors and bicuspids. Since in moving a tooth the greatest change takes place at the neck the greatest absorption and deposition of bone must take place at that point. The roots of the cuspids are

larger and longer than those of any other teeth in the jaw. Unlike other teeth, the germs are situated considerably higher and farther toward the outside of the alveolar process, hence when they come closely into position they diverge from the apices to the crowns. All other teeth stand nearly or quite perpendicular, hence the roots of these teeth do not influence the hard palate. The first permanent molar and the teeth posterior to it are never involved, except from local causes. The center of the buccinator muscle in both directions is located at this tooth. How, then, since all the teeth are covered by the muscle upon one side, can half be carried inward and the other half remain normal?

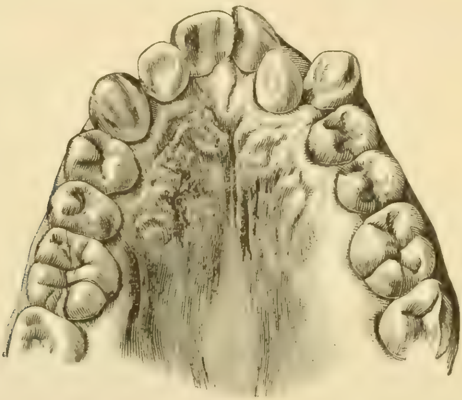


Fig. 92.

Again, were mouth-breathing the cause of the contraction, both sides should contract alike, and the deformity be uniform upon both sides. This is never the case. The want of uniformity of the two sides is easily recognized. Muscles cannot contract to a degree sufficient to induce the pressure necessary to produce a deformity. Some of the muscles of the chest exert much more pressure in respiration than it is possible for the buccinator to do during sleep, yet no one would expect to find the ribs modified by this process. Pressure of the contractile tissue upon the crowns of teeth is not sufficient to affect the alveolar process through the roots of the teeth. Even if it could modify that spongy structure, its force must stop there and would not extend to the osseous vault and result in bending it out of shape.

In most cases the diameter of the superior maxilla, its alveolar process and teeth is less than that of the inferior maxilla, alveolar process and teeth. This is always the case in the worst forms of irregularities of the teeth. In such cases, the muscles and cheek could not press upon the teeth and alveolar process of the upper jaw. The changes which take place in the bone are not a bending in at one place and a forcing out at a weaker point to compensate for the space lost, but an absorption and deposition of bone at the point of pressure. Even if these last conditions were the case, the strong pillar of bone situated at the very point of contraction of the alveolar process, together with the nasal

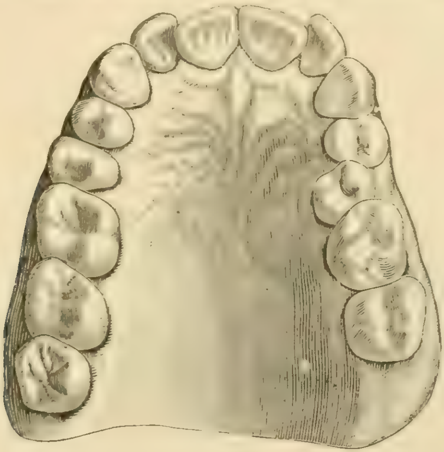


Fig. 93.

septum would constitute a strong bulwark for resistance to the pressure, which is suppositiously acting at a distance from the top of the vault. It would be as impossible to produce sufficient pressure to break the dental arch as it would be for the weight of a building to break the arch of a door or window. The tongue exerting much greater force in the act of swallowing, would prevent inward movement of the teeth if the slight pressure from the cheek muscles were the cause of the deformity.

Were it possible for the buccinator muscle to produce this contraction, the modification of the osseous structures must be uniform. This would shut out the semi-V-shaped (Fig. 92) and semi-saddle-shaped arches entirely (Fig. 93), and a majority of

other irregularities of the teeth in which there is bilateral asymmetry. The bilateral muscle cannot act on one side while that on the opposite side remains passive. Partial V-shaped (Fig. 94) and partial saddle-shaped (Fig. 95) arches make the theory still less tenable. In these varieties are sudden bends inward where only one or two teeth may be involved. These aberrations could only be produced by a centralization of force on one given point or fiber of muscle. The muscle being penniform in shape, it would be impossible for one or two fibers of the muscle to exert their influence upon a bicuspid. It would naturally lap two or more teeth. Lastly, if the buccinator acts as all muscles do—

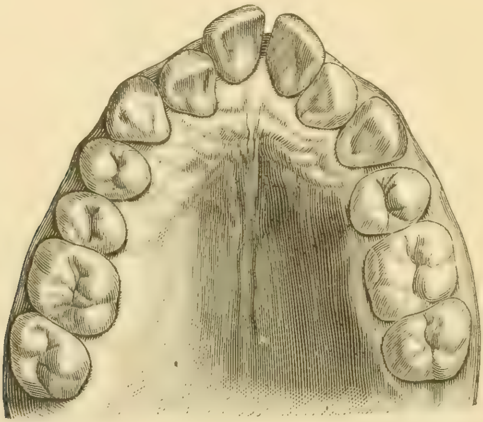


Fig. 94.

uniformly throughout its extent of contraction—it is just as efficient below a median bisecting line in producing a narrow, contracted arch as in its upper portion. Therefore, the lower maxilla should be contracted whenever the upper one is, an evident impossibility. A V-shaped arch can never occur upon the lower jaw if the teeth articulate normally, because these teeth strike inside of the upper and are thus prevented from moving forward. A saddle, partial saddle or semi-saddle arch may occur on the lower jaw, but these deformities are not often seen. When they do occur, they are the result of improper occlusion with the teeth of the upper jaw. In semi-V and partial V-shaped arches the alveolar process is always contracted

upon the side of the deformity. If one side of the arch be contracted more than the other, the alveolar process is contracted in proportion to the amount of deformity; the vault on that side is not carried up beyond the other side, which is normal. In the saddle, semi-saddle and partially saddle-shaped arches, the alveolar process is built up about the teeth in precise conformity to the nature of the shape of the arch. If three thousand models of the upper jaw were arranged in groups according to the forms here represented and the arrangement of the teeth in each group examined very closely, no two are alike in either group. An external force acting upon the jaws from the outside

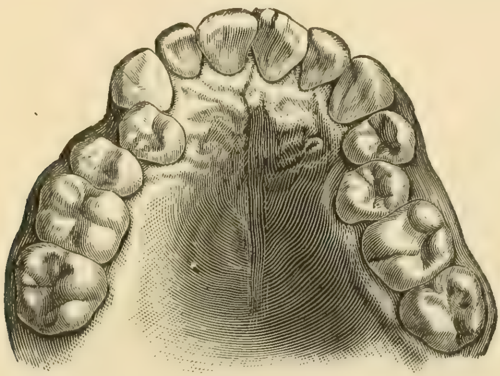


Fig. 95.

could hence not possibly be a cause. If that were possible all models of one variety would have a definite type (Table XXIX).

In order to further settle the question of mouth-breathing, I present the following models of patients over twelve years of age. They number from 1 to 24, the order in which the impressions were taken. A sufficient number of cases are here illustrated to show the general outline of the jaws and teeth of the average mouth-breather.

Very few of these cases have contracted arches, as a rule, the vaults are less than the average in height. No two cases are exactly alike, which would be the case if the contracted jaws were caused by lateral pressure of the cheeks. Many cases were seen in consultation with Hawley, H. H. Brown and Pynchon.

Case I, Fig. 96. A thirteen year old boy of Canadian-French extraction, born in Chicago. Height of vault, .53 of an inch. Has always breathed through the mouth. Adenoid growth in post-nasal spaces. Collapsed condition of alæ nasi. The teeth were late in erupting. The bicuspids were all through upon the right side. The cuspid was just coming into place, while upon the left side the second temporary molar was yet in position. The first molar had just been removed. The first bicuspid was coming in its place. The cuspid was not so far developed as its fellow of the opposite side. The second permanent molars should have been in place, but were tardy in development.

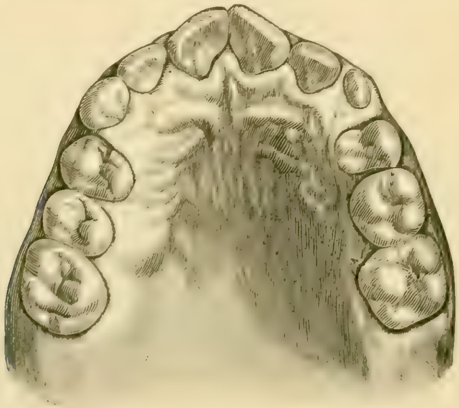


Fig. 96.

While the general contour of the jaw was normal posterior to the cuspids, there was a tendency of the incisors to contraction, with a protrusion of the mesial surface of the centrals. The cuspids were erupting anterior to their normal position, thus crowding the incisors together.

Case II, Fig. 97. A nineteen year old boy, American. Height of vault, .75 of an inch. He commenced to breathe through the mouth at the age of nine years, at which time his nose was broken. There was arrest of development of the bones of the nose. There were adenoid growths. Hearing and eyesight were poor.

The jaw in this case was well developed with a normal palate,

but higher than the average, being three-fourths of an inch in height. All the teeth had erupted. The anterior teeth had a tendency to contraction, due to tendency of the teeth to push forward. The central incisors did not protrude, as in Case I, because the lateral incisors overlapped them. The right side of the arch tended to assume the saddle-shaped deformity from the position of the bicuspids, caused by too long retention of the temporary teeth. The two sides were markedly asymmetrical. This case shows that were contraction of the jaw due to contraction of muscles in mouth-breathing, both sides would be alike.

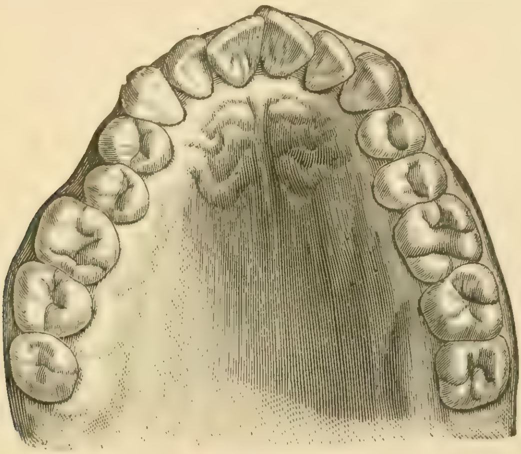


Fig. 97.

Case III, Fig. 98. A thirteen year old American girl. Height of vault, .46 of an inch. She had scarlet fever at the age of five years and commenced to breathe through the mouth at eight. There was arrest of development of the bones of the face and nose.

This was a well-marked case of defective development of the superior maxilla and arrest of development of the bones of the face and nose. As in Case I, the second molars had not yet made their appearance. The central incisors overlapped, but did not protrude. The right side of the arch tended to assume the saddle-shaped deformity from the position of the bicuspids. The cuspid had not fully erupted on this side and was still more

tardy in its appearance on the left. The two sides were asymmetrical and the height of the vault a little less than the average. When the second and third molars appear, an unusual protrusion of the anterior teeth must necessarily result in order to give sufficient room for the molars. If this were allowed to progress without mechanical interference a marked V-shaped deformity would result.

Case IV, Fig. 99. A twenty-one year old American. Height of vault, .68 of an inch. He had been a mouth-breather all his life. There was deflection of the septum nasi which at the age of fourteen was operated upon without any result. The bones of

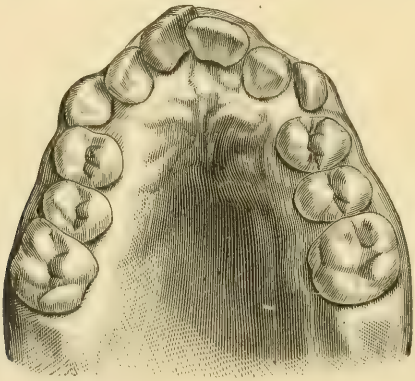


Fig. 98.

the nose were well developed. Those of the face were slightly arrested.

While the jaw was not quite as large as normal, the teeth were regular, well developed and without a cavity. A more nearly perfect arch is rarely found. The articulation with the inferior maxilla was at all times exact.

Case V, Fig. 100. A fifty-two year old American. Height of vault, .43 of an inch. He always breathed through the mouth. The bones of the nose and face were well developed. A year before coming under care had had hypertrophied bone removed from nose. Eyesight and hearing are good. The jaw is well developed and shows no deformity.

Case VI, Fig. 101. A seventeen year old American girl.

Height of vault, .65 of an inch. She has not always breathed through the mouth. She had adenoid growths. She had had measles and chicken-pox. This jaw was considerably contracted throughout, but more noticeably through its lateral diameter. The alveolar process was hypertrophied on either side, the hypertrophy being more marked on the right side.

Case VII, Fig. 102. A seventeen year old American girl. Height of vault, .65 of an inch. She had always breathed through the mouth and had had post-nasal catarrh. She had had measles and whooping-cough. The jaw was arrested in its development. The first bicuspids had been extracted to make room for other

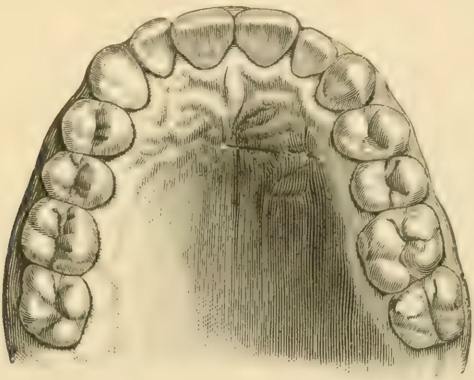


Fig. 99.

teeth. The lateral incisors overlapped the centrals because of a lack of room before extraction of the bicuspids. The jaw was asymmetrical, the left side diverging to allow eruption of second molar.

Case VIII, Fig. 103. An eighteen year old American boy. Height of vault, .59 of an inch. He always breathed through the mouth. He had scarlet fever at eighteen months. He received a blow upon the nose which caused left deflection of the septum nasi. The left nostril was entirely closed by hypertrophy of bone and mucous membrane. There was slight hypertrophy of the mucous membrane of the right nostril and hypertrophy of the mucous membrane in the post-nasal space. There was

arrest of development of the bones of the nose. This case has marked arrest of development of the entire jaw. The anterior teeth were much crowded. On the left side the left lateral incisor had rupted within the arch; that of the right side partially. The cuspids had erupted outside of the arch. On the right side the sixth year molar had been extracted, in consequence of which the second molar had been pushed forward.

In this case the small jaw was inherited from the mother and in harmony with the bones of the face. The teeth which were exceedingly large and had long roots were inherited from the father. They were so out of proportion to the small jaw that the posterior teeth had moved forward and filled the spaces intended for the cuspids.

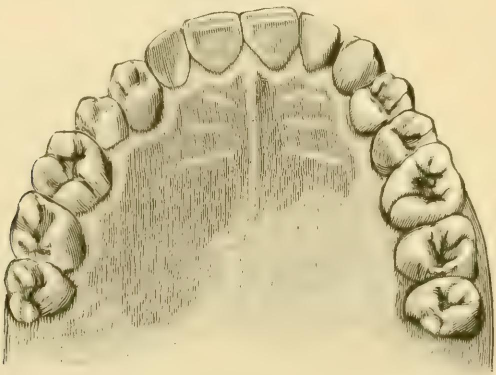


Fig. 100.

Case IX, Fig. 104. An American medical student, aged twenty-five. Height of vault, .71 of an inch. He commenced to breathe through the mouth at ten. There was marked arrest of development of the bones of the face and nose. The nasal cavities were small. The nasal septum was deflected slightly to the right. There was hypertrophy of cartilage on the left side. The mucous membrane was slightly thickened. The posterior nasal cavities were clean.

The patient had measles, chicken-pox, mumps and two attacks of pneumonia. He had severe rheumatism at twenty-one. At the time of examination there was tuberculosis of the left ankle.

On examination of the jaws, it was found that; The lower jaw was excessively large. Although all of the teeth of the lower jaw tip inward, yet the outer cusps of the upper teeth just touch the inner cusps of the lower teeth. There was marked arrest of development of the upper jaw. On the right side the arch had a tendency to assume the saddle-shaped deformity. On this side the cuspid had erupted externally to the arch. Between the central and the lateral incisors its mesial surface was directed inward. The lateral incisor was internal to the other teeth. The lateral incisor on the left side was situated internally to the central incisor and cuspid. It had caused a slight rotation of the central incisor. The second molars were

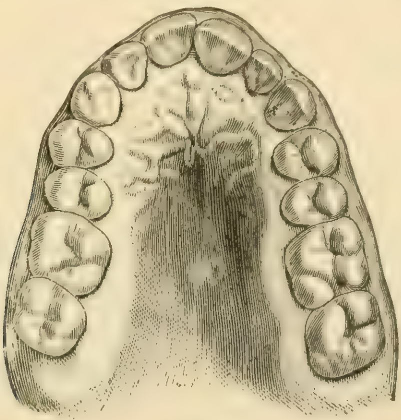


Fig. 101.

small and had erupted externally to the first molar on account of lack of room in the jaw. The alveolar process and mucous membrane were hypertrophied. At the time of formation of the irregularities of the teeth the alveolar process and mucous membrane began to hypertrophy. Coincidently with these there was arrest of development of the bones of the face, nose and jaw and the habit of mouth-breathing was formed.

Case X, Fig. 105. A thirty-four year old German. Height of vault, .71 of an inch. He had always breathed through the mouth until an operation four years previous to examination. He had had scarlet fever and measles. This jaw was well devel-

oped. The central incisors overlap slightly from the result of interstitial gingivitis. The left side had a tendency to assume the saddle-shaped deformity from the position of the bicuspids. This was probably assumed because of too long retention of the temporary teeth. The crowns of the molars had decayed and broken off. The thickening of the mucous membrane was the result of interstitial gingivitis.

Case XI, Fig. 106. A thirteen year old American boy. Height of vault, .62 of an inch. He had breathed through the mouth for six years, before coming under observation. There was arrest of development of the bones of the face and nose. The patient had considerable catarrh and had been treated for irregularities of the teeth. The jaw was much contracted, espe-

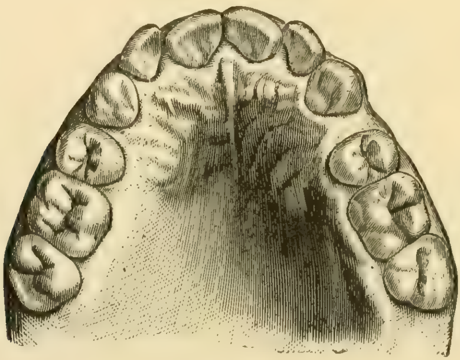


Fig. 102.

cially in the anterior part. On the right side the lateral incisor was deformed and represented by a conical tooth situated internally to the other teeth. Posterior to this was the temporary cuspid. Because of retention of this tooth the permanent cuspid was erupting externally to the other teeth and between the temporary cuspid and permanent central incisor. On the left side the lateral incisor was deformed in a similar manner to that on the right, but its position was normal. The left temporary cuspid remained. As there was insufficient room in the jaw for the second molars, the teeth anterior to these moved forward, producing the V-shaped projection of the central incisors.

Case XII, Fig. 107. A fifteen year old American. Height of vault, .53 of an inch. There was deflection of septum nasi and thickening of mucous membrane. The patient had always breathed through the mouth. The small jaw was inherited from the mother and the large teeth from the father. The dental arch was contracted anterior to the cuspids and the anterior teeth were crowded. Posterior to the cuspids the dental arch was normal. The first bicuspid on the left side had been removed to afford more room for the outer teeth. The corresponding tooth on the right should also have been removed. As it was allowed to remain it caused a crowded condition on that side. The incisor passed beyond the median line of the jaw, encroach-

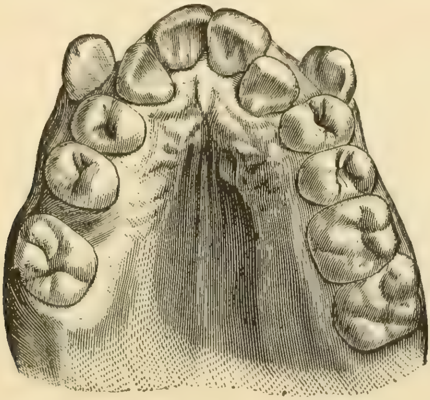


Fig. 103.

ing upon the other side. Because of insufficient room in the jaw for the second molars, the teeth anterior to these had pushed forward, producing the V-shaped protrusion of the central incisors.

Case XIII, Fig. 108. A twenty year old man. Height of vault, .71 of an inch. He had always breathed through the mouth. The alveolar process was well developed. The maxillary bones were arrested in their development. The left nostril was entirely closed. There was hypertrophy of the mucous membrane of the right nostril. He had had scarlet fever and whooping-cough. There was arrested development of the maxillary bones in this case, but no deformity had been produced as

the teeth had crowded the alveolar process upon the outer surface of the bone, thus forming a large arch. The only irregularity of the teeth was on the right side, where the lateral incisor, by erupting slightly within the arch had pushed the distal surface of the central incisor slightly outward.

Case XIV, Fig. 109. A thirty-nine year old Canadian. Height of vault, .71 of an inch. He had always breathed through the mouth until he came to Chicago, in 1884, since which time he had gradually improved and could breathe at time of examination partially well. He had always suffered from catarrh. When a cold is taken, the nasal mucous membrane becomes

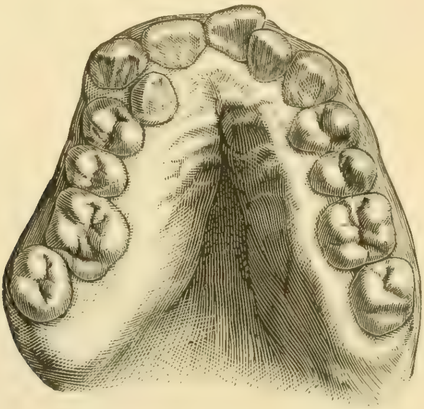


Fig. 104.

inflamed and mouth-breathing resulted. There was a marked arrest of development of the jaw. Because of the small size of the jaw, the teeth anterior to the molars pushed forward and became crowded when the molars erupted. Upon the left side the second bicuspid had been removed, affording sufficient room for eruption of the second molar on that side.

Case XV, Fig. 110. An eight year old Canadian. Height of vault, .43 of an inch. She had always been a mouth-breather. She had suffered from catarrh for five years previous to coming under observation. Her general health had improved since removal to Chicago, six months previously. There was marked arrest of development of the superior maxilla.

A case at the age of eight years is of unusual interest in connection with the principles advanced in this work. The usually low elevation of the vault was due to lack of development. The normal height was reached at the proper age. The temporary molars and cuspids upon the left side and the temporary second molar upon the right side were extracted, just before securing the model. Although the permanent bicuspids and cuspids upon the left side were not visible yet the appearance of the alveolar process led to the belief that their position will be normal. Upon the right side all the teeth except the cuspid belong to the permanent set. The cause and manner of the

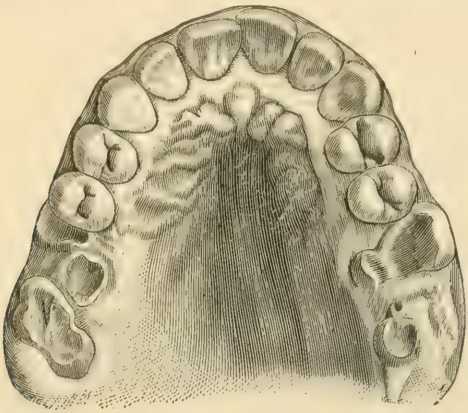


Fig. 105.

production of the saddle-shaped arch upon this side of the jaw was shown in the position assumed by the second bicuspid and first permanent molar. Upon removing the temporary molar, the crown of the bicuspid was seen to be exactly in the position represented. The first permanent molar moving forward had crowded the cuspid into the roof of the mouth. The V-shaped appearance of the incisors was due to lack of room in the jaw for their normal eruption.

Case XVI, Fig 111. A thirteen year old Hebrew-American girl. Height of vault, .59 of an inch. There was adenoid growth in the post-nasal space. She was unable to breathe through the nose. The arrest of development was very marked and the

maxilla unusually small. The lateral incisors had never erupted. The cuspids had moved forward and taken their places. The jaw was very narrow across at the bicuspids and much contracted anteriorly to them. The jaw was of marked V-shape.

Case XVII, Fig. 112. A thirteen year old American boy. Height of vault, .62 of an inch. He had breathed through the mouth for six years ere observation. There was considerable arrest of development of the bones of the nose. The left nostril had collapsed and the right nostril partially. The patient could breathe through the left only and with difficulty. The jaw in this case was well developed. The forward movement of the incisors

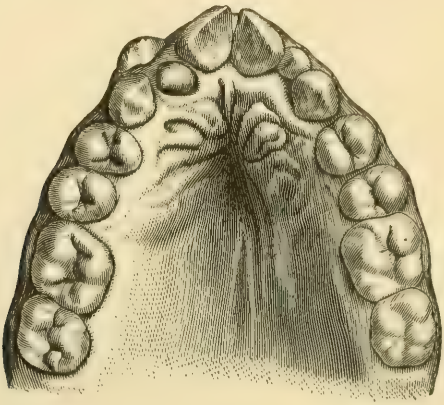


Fig. 106.

was due to a local factor of irritation, produced by the lower teeth striking against the roof of the mouth. This caused a deposit of bone-cells at that point.

Case XVIII, Fig. 113. A fourteen year old American boy. Height of vault, .59 of an inch. He had always breathed through the mouth. The septum nasi was deflected. There was hypertrophy of the mucous membrane. The left nostril was closed. In this case the jaw was well developed. Although the teeth were large there was no marked deformity. The central incisors overlapped slightly. The anterior teeth protruded on account of the pushing forward of the posterior teeth. A side view shows this forward inclination of the teeth.

Case XIX, Fig. 114. A twenty-five year old American man. Height of vault, .62 of an ich. He had been a mouth-breather for twelve years. The left nostril was entirely closed, from a blow at the age of thirteen. The jaw was well developed. The slight saddle-shaped appearance of the right side was due to the position of the second molar had crowded the first molar forward and inward. On the left side the first molar had been removed. The second molar had moved forward, partially filling the space.

Case XX, Fig. 115. A sixteen year old American. Height

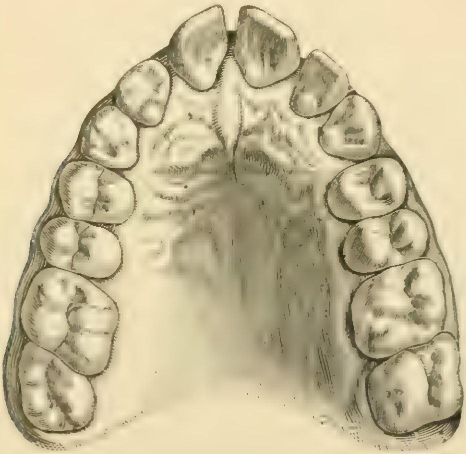


Fig. 107.

of vault, .59 of an inch. Always has been a mouth-breather. There was present a complete collapse of the nostrils. There was a small jaw anterior to the cuspids. There was slight protrusion of the anterior teeth and alveolar process. On the left side the lateral incisor had erupted slightly inward relatively to the central incisor and cuspid. There was marked asymmetry; the left side was quite undeveloped.

Case XXI, Fig. 116. This woman patient had always been a mouth-breather because of the thickening of the mucous membrane of the nose. The development of the maxilla had been arrested. There was considerable protrusion of the anterior

teeth and alveolar process, from lack of room. Associated with this was interstitial gingivitis. The jaw was narrow and compressed in the region of the bicuspids. On the right side the first first bicuspid had been extracted to afford room for the other teeth. The left lateral incisor was small. The left bicuspids were situated within the arch, erupting in this position because of retention of the temporary teeth. This side approximated the saddle-shaped deformity.

Case XXII, Fig. 117. A sixteen year old American boy. Height of vault, .50 of an inch. He had been a mouth-breather for ten years. The anterior part of the jaw was contracted,

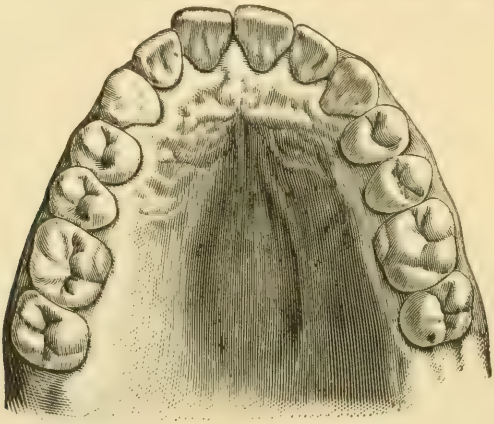


Fig. 108.

approximating the V-shaped deformity. There was no irregularity of the teeth.

Case XXIII, Fig. 118. A twenty-six year old American man. Height of vault, .75 of an inch. He had always breathed through the mouth. There was lack of harmony between the size of the jaw. The teeth, in consequence of which the anterior teeth had erupted irregularly. The central incisors overlapped slightly. The approximal surfaces of the lateral incisors were internal to the palatine surfaces of the centrals. Posterior to the cuspids the dental arch was normal.

Case XXIV, Fig. 119. A twelve year old American girl. Height of vault, .53 of an inch. She has always breathed through the mouth. Septum nasi was deflected. The left nostril was

closed. The anterior part of the jaw was contracted. In consequence of this contraction the central incisors protruded. The lateral incisors were slightly internal to the centrals, lack of room in the jaw preventing them from assuming their normal position. The cuspids were erupting. On the left side the second temporary molar was present.

Thirty-six impressions of the mouths of children, ranging from six to twelve years (Plates 1 to 6, see third edition), for the purpose of showing development of the vault. These impressions were taken in modelling compound as the children came who were not selected as regards conditions of the mouth. Two

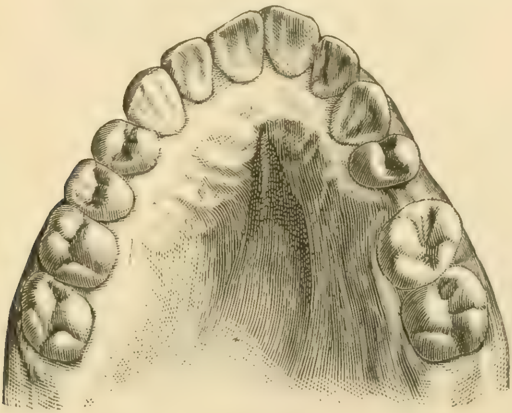


Fig. 109.

sets of models were prepared, one for the lithographer and the other for study. A sufficient amount of compound was used so that the surplus would extend backward and downward in order that the contour of the soft palate could also be secured. This was accomplished by the patients placing the tongue against the compound and breathing through the nose. Measurements were first taken of the models and then they were sawed at the median line. One-half was placed upon paper and an outline taken; then the halves were glued together and the saw passed through the model transversely, just anterior to the first permanent molar, then the anterior part was outlined, thus, in this manner, the illustrations were taken accurately. While litho-

graph plates do not give as accurate an illustration of a model as might be desired, they are sufficiently exact to show relation of the teeth to the jaw at the period indicated on each plate. These, together with the antero-posterior (Plates 1, 3, 5, 7, 9, 11)

Fig. 110.

and lateral illustrations (Plates 2, 4, 6, 8, 10, 12), give a very good idea of the progress of development from the development of the first permanent molar through the period of shedding the temporary teeth and their places filled with the second set.

The studies were begun at the sixth year, since jaw deformities are rarely before that period. The changes which take place

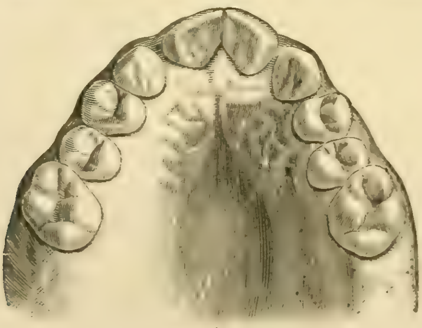


Fig. 111.

in the jaws and vault are usually noticed between the ages of six and twelve, they being dependent upon the time of the eruption of the permanent teeth anterior to the first permanent molars. There were three models at six years and three at seven

years. The changes in the vault are so slight that more would be useless.

Certain conditions in the contour of the vault which must not be lost sight of, can be easily studied in these models. In a general way the vaults are quite low and without character.

Starting at the median line of the cross sections (Plates 2, 4, 6, 8, 10, 12), the vault is quite narrow at the upper portion and the lines in either direction diverge until the teeth are reached. The teeth also diverge outward. Very few of the models contain bicuspid teeth until the eleventh year.

The alveolar proces is quite thick in the sixth and seventh

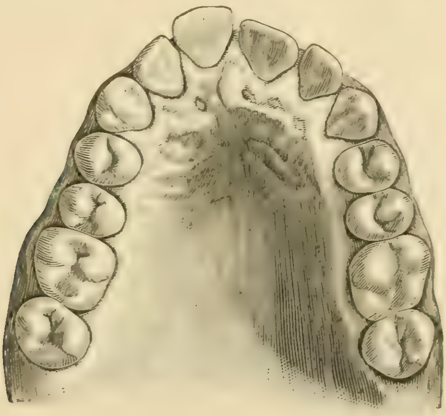


Fig. 112.

year models, but lengthens and becomes thinner as age advances. The thickness arises from the antrum being located between the inner and outer plate of bone, and the alveolar process not only contains the roots of the temporary teeth, but the crowns of the permanent teeth as well.

The height of vault is very low, while there is not always a gradual advance from year to year, yet, taken as a whole, from the sixth to the twelfth year there is quite an advance in height. The normal height of vault is not reached until the permanent teeth are all in place, which would be after the twelfth year. If a line should be dropped from the center of the arch, the two lateral halves with but few exceptions would be nearly alike.

A slight ridge at the top of the vault extends along the median line (Figs. 2, 5, 6, 8, 12, 16, 24, 25, 30, 33, 34 and 36). A much more prominent ridge may occur in the mouths of children at two years (Plate A). Upon either side of the ridge there is an apparent groove, sometimes slight and again quite marked, extending frequently only a short distance, then again quite an extent and sometimes the full length of the suture. It is not always in the same location, sometimes in the alveolar process behind the incisors, again at the center and often at the posterior part of the vault; however, it is more frequently observed in the anterior part of the vault than in the posterior, and sometimes more marked upon one side than upon the other and again only

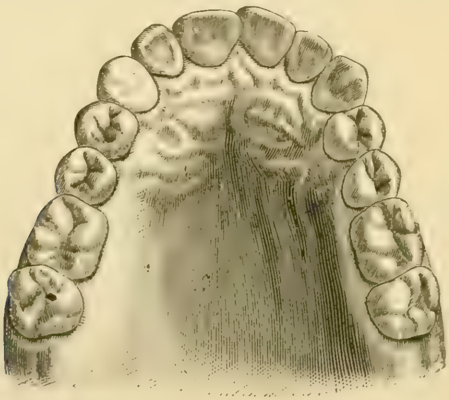


Fig. 113.

upon one side. In the cases illustrated by Figs. 3, 6, 12 and 19, and Plates 1, 2 and 4 (see third edition), the first permanent molars have been extracted.

In the models of the eleventh and twelfth years, the second bicuspids are seen coming down into place, although many of the temporary teeth are still in the jaw. Unlike the temporary molars, these teeth come down vertically. Although they have not fully erupted, quite a change has taken place in the length and width of the alveolar process and more character is evident in both the antero-posterior and lateral curves.

In the antero-posterior section (Plates 1, 3, 5, 7, 9 and 11)

the following changes are noticed: The temporary incisors are (Fig. 1) decayed down to the gums. The permanent central incisors are (Figs. 5, 6, 7, 8 and 11) just making their appearance, while in others they are about half way through or are fully developed.

Just back of the incisors a thickening of the alveolar process is evident; in some quite thick, in others thin. This is due to the relation of the temporary incisors to the permanent ones. If the temporary tooth remain in the jaw until the permanent one comes nearly through, the alveolar process is much thicker than if the temporary tooth be removed earlier. It is the foundation

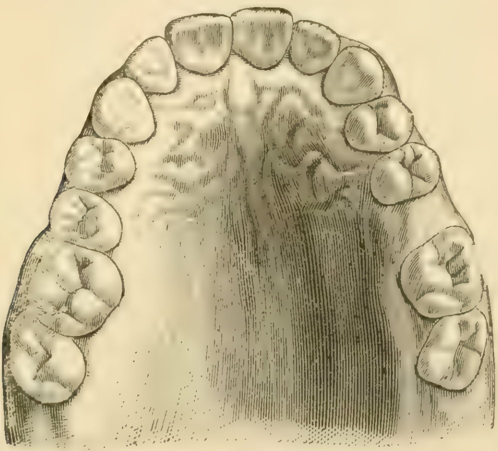


Fig. 114.

upon which the long, thin alveolar process builds when the permanent teeth are in place. By following the line backward, very little character is noticed in the curves. As the child grows older the evolution of development becomes more pronounced. Deviation in the curves results in varied ossification of the suture. Sometimes the ossification is uniform throughout, in which case the line will be uniform and graceful (Figs. 1, 2, 3, 7, 9, 10, 11, 15, 16, 17 and 21). If the ossification be irregular, then the lines become wavy and irregular (Figs. 4, 5, 6, 8, 12, 13, 14, 18, 19 and 20).

The soft palate is very accurately illustrated in relation to

the hard palate. The older the patient grows the longer the antero-posterior line becomes. This is to be expected, since development of the jaw is posteriorly direction. Shape and inclination of the soft palate depend upon the distance between the posterior surface of the hard palate and the forces.

In the models (Plate 1, see third edition, at six and seven years) the six year molars are in place and all the temporary ones (except in Figs. 3 and 6, where the temporary incisors have all been removed); the left central (Fig. 6) is coming into position. As far as contour of the teeth is concerned, it is normal.

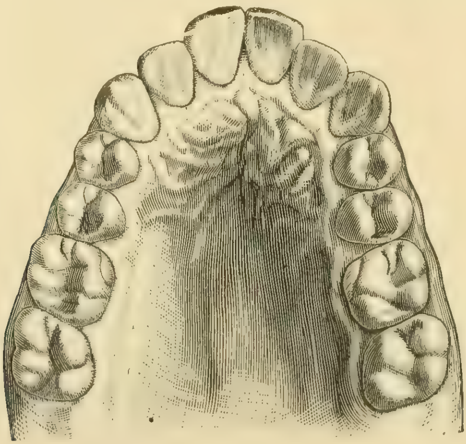


Fig. 115.

At eight years (Plate 2, see third edition) the first permanent molars and central incisors have erupted in all but one of the cases (Fig. 12), where the first permanent molars have been extracted. None of the other permanent teeth have yet made their appearance. In this plate a change is seen taking place in the shape of the vault. The V arch is beginning to develop (Figs. 7 and 9), and in the semi-saddle (Fig. 11) local irregularities of the teeth are observed (Figs. 8 and 19).

At nine years (Plate III, see third edition) deformities of the jaws are still more marked. A semi-saddle is nicely outlined (Fig. 13), a V-shaped arch is noticed (Figs. 14, 15 and 16),

while in others the permanent teeth are not far enough advanced to tell what position they will occupy (Figs. 17 and 18).

At ten years (Plate 4, see third edition) the teeth are little

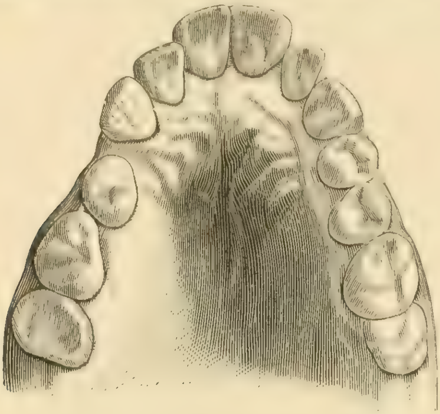


Fig. 116.

further advanced than at nine years. The bicuspids are just pushing their way through and the jaw seems to be taking on character. In one case the central incisors are crowding their way to the right, producing a marked deformity of the jaw. In

Fig. 117.

another case (Fig. 20) the incisors are crowding to the right and the left cuspid just coming through the gums, producing a semi-V-shaped (Fig. 19) arch. The temporary teeth in another case

are shed (Fig. 21), and the bicuspids first coming through The permanent teeth are not far enough advanced to decide exactly what deformity will be produced. From lapping of the central incisors, and eruption of both bicuspids before the cuspids, it is safe to say that a V-shaped arch will occur. The permanent teeth (Figs. 22, 23 and 24) are not far enough along to judge what the results will be.

At eleven years (Plate 5, see third edition) the deformities are still more easily traced. In one case (Fig. 25) a local irregularity—a crowding inwards of the right central incisors—are due to want of room, has been produced by the forward movement

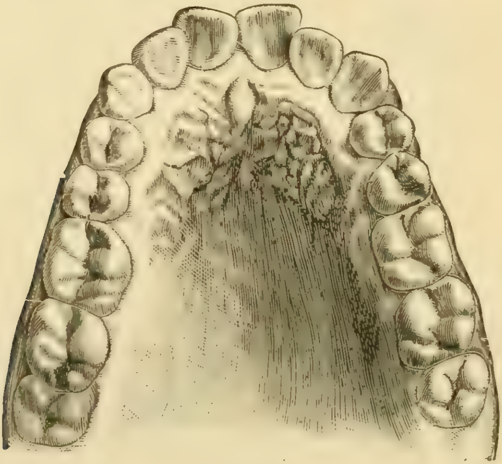


Fig. 118.

of all the teeth on the right side. V and saddle arches are well illustrated (Figs. 28, 29 and 30). Arrest of development of the maxillary bones has occurred (Fig. 28), and a marked V arch will result. This model is from the model of a boy seventeen years old. His body became arrested in development at nine years of age by an eruptive fever.

At twelve years (Plate 6, see third edition) the temporary teeth are yet noticeable in many of these illustrations. It is easy, however, to outline the forms of irregularities that will be produced when all the permanent teeth are in place.

The date and the character of the vault deformities that will

be produced when all the permanent teeth are in place, namely, between the sixth and twelfth year, or at the time of the development of the permanent teeth, are shown as well as the fact that vault deformity will depend upon the manner in which the teeth came into the jaw and whether there will be a V or saddle-shaped arch with their modifications, partial V or saddle, semi-V or saddle.

The shape of the vault is also changed by local irregularities of the teeth. Here any tooth may stand inside or outside the dental arch and the vault will conform to the deformity.

The deformity of the vault is not observed until at or about

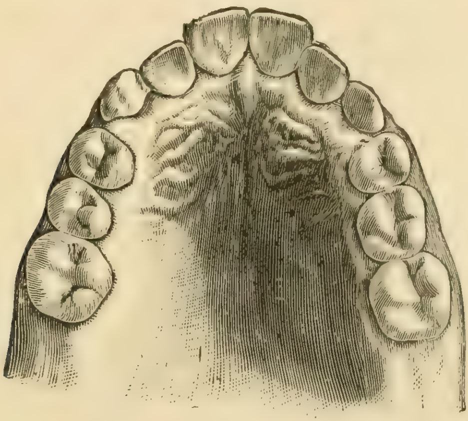


Fig. 119.

the sixth year, or the time of the eruption of the permanent teeth. The ossification of the suture, uniting the maxillary bones at the median line takes place at different intervals—sometimes as early as the eighth week of intra-uterine life and as late as the sixteenth.

Excessive development of the suture may occur as early as the second, and as late as the thirty-sixth year. This excessive development takes different shapes and forms; 228 Peruvian skulls, 240 Stone Grave skulls and twenty-one Mound-Builders' skulls, sixteen Peruvians, thirty-nine Stone Grave and one Mound-Builder's (all of which had large, well-developed jaws, normal in shape) had a rope-like projection extending the entire

length of the suture. This development was unlike the excessive development of modern skulls. It had the appearance of having been first made and then glued upon the suture (Fig. 120, No. 1).

The deformity of the suture (Nos. 2, 3, 4, 5 and 6) may vary in proportion to the width of the arch, in the narow arch the suture is low or thick, while in the normal arch it is flat. The grooves of either side of the suture are not uniform, one side being deeper than the other.

It has been claimed that these grooves are due to ossification of the vomer, producing rigidity of the suture and the bone upon either side is afterward carried up.

According to Clouston, "Those palates where the deformity consisted in a ridge down the center antero-posteriorly, seemed to show that in them the deformity took place at a later period than in the other deformed palates. When the nasal septum was getting stronger and kept the center of the palate down, while on each side of it the palate was drawn up making two vaults side by side, instead of one." Six models are shown (Plate A), ranging from two to six years. At two years there is (Fig. 1 and 2) a ridge extending from a line drawn across the vault at the cuspids, through the entire length of the jaw. This may begin in the center of the vault at a line drawn across the first temporary molar.[7] At three years of age (Fig. 3) there may be a slight ridge just back of the incisors, extending only a short distance, when the center of the vault is perfectly flat, and the ridge begins again in the posterior part of the vault. At four years (Fig. 4) the ridge may start at a line drawn across the vault at the first molar and extending the entire length of the suture. At five years (Fig. 5) a broad ridge may extend the entire length of the vault. At six years (Fig. 6) a very narrow ridge may extend the entire length of the vault.

As the vault ossifies as early as the first or second year, and as the ridge is also found as early as the second year, the vomer

[7] I have a number of these models showing the ridge at the second year and observed many more in practice. Since the two halves of the maxillary bones do not ossify till the eighth week of foetal life, it can readily be seen that where ossification is not complete these ridges would form when the child begins to masticate its food.

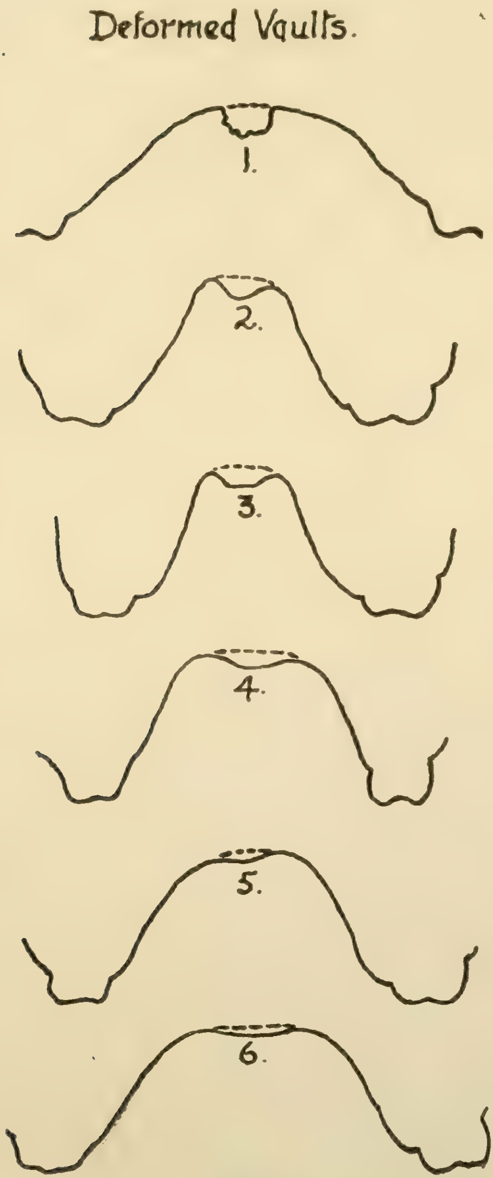
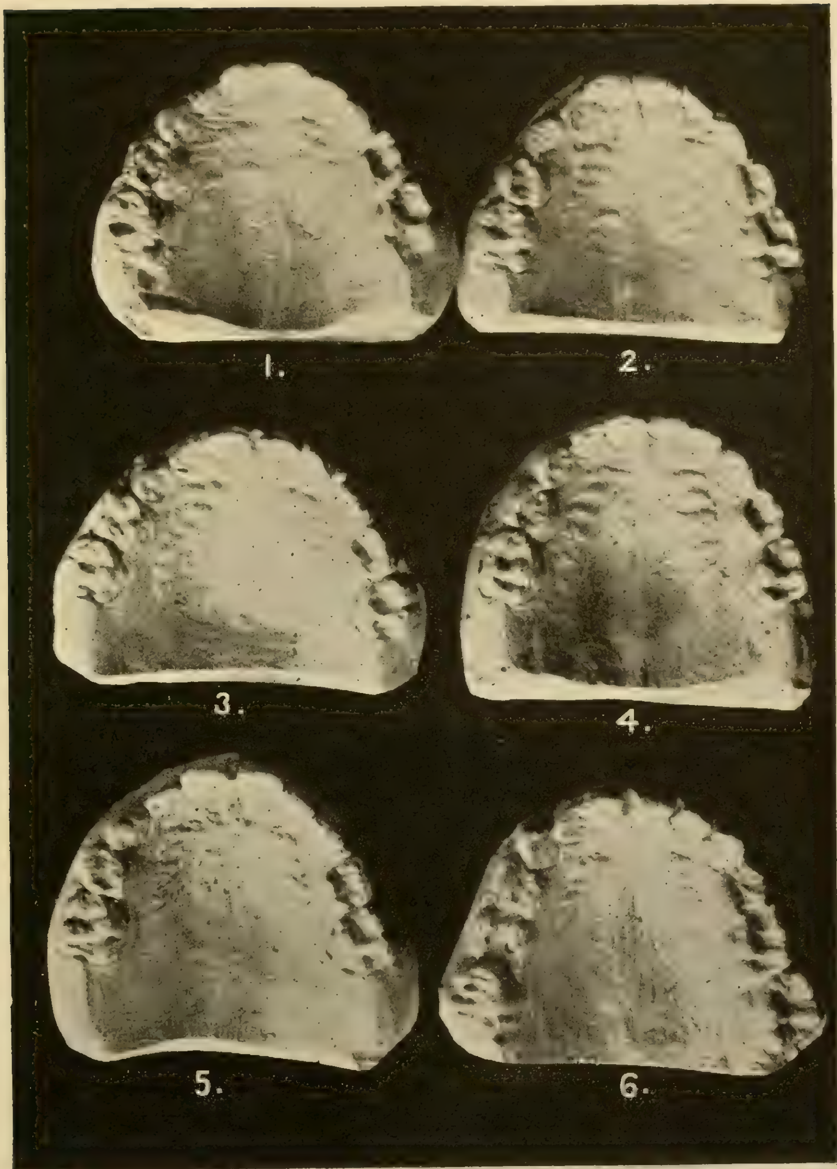


Fig. 120.

not ossifying until later in life, Clouston's theory does not explain the facts. The ridge takes so many different shapes that when a number of models containing it are examined the theory that the sides of the arch are drawn or pushed up appears more and more untenable. Thus come models (Figs. 7 and 8, Plate B) showing vaults similar to No. 2, Fig. 120, except the grooves are deep and sharp. In Fig. 7 it extends from just back of the incisors to opposite the second molars, where the arch becomes perfectly smooth throughout the balance of the hard palate. Fig. 8 it commences at the same point and stops opposite the first permanent molar. These models demonstrate the fallacy of this theory, since nothing could force the deep grooves in the anterior alveolar process, as suggested by many authors, since the vomer extends through and beyond the anterior surface of the anterior alveolar process to form the nasal spine. If such a thing were possible, the posterior part of the vaults, which would easily yield to force would be affected. This is not the case. The ridge extends to the second molar, or as far as the grooves. One of the jaws is very small and contracted with slight hypertrophy extending all around the inner surface, giving the sharp appearance to the grooves; the other is a little larger, has not hypertrophy, hence the groove upon either side of the suture is not so narrow, although fully as deep. In Figs. 9 and 10, Plate C are well developed jaws with very broad ridges. In Fig. 9 the ridge commences about opposite the first bicuspid and extends back as far as the second molar tooth. In Fig. 10 the ridge extends from the alveolar process just back of the incisor to the second molar; both are about the same width. The grooves upon either side are very shallow and about the same depth of ridge. These are similar to those of Nos. 4, 5 and 6, Fig. 120. In Fig. 11, Plate D, is seen a very small jaw with a marked ridge commencing in the alveolar process back of the incisors and extending as far as the second molars; the grooves upon either side are very deep and sharp. This is due to a small jaw and hypertrophy of the alveolar process. There is occasionally a groove in the center of the vault running the entire length of the suture in place of the ridge, as Fig. 12, Plate D. This is due to arrest of development of the suture

PLATE A.



and hypertrophy of the palate bones and mucous membrane upon either side of the suture. This groove is sometimes shallow, again deeper, sometimes broad and again narrower, this depending upon the extent of the hypertrophy.

The two sides of the contracted arches are not uniform. This is due to the location of the teeth in the alveolar process more in upon one side than upon the other, carrying the alveolar process with it. The sides of the palate are not carried up since there is no force to move them. These deep grooves may be situated entirely in the anterior alveolar process; sometimes entirely on one side; sometimes in the center of the vault in the anterio-posterior direction, and again in the posterior part of the vault.

The location of these grooves, especially those in the alveolar process, and the fact that sometimes they extend only .25 to .50 of an inch, renders such a theory untenable. If the sides were carried up, owing to the very thin bone, a like projection would extend into the floor of the nose. I have examined 1,367 skulls with this deformity and I have yet to find the first instance of this projection. In every case the floor of the nose and commencement of the septum were smooth and evenly developed throughout its entire length. How, then, are these deformities to be accounted for? These projections are developed as early as the second year, and as late as the thiry-sixth year. They are, hence, the result of excessive development of the suture, due to irritation set up at the time of ossification, by mastication. The lower jaw develops laterally faster than the upper, thus crowding the superior maxillary bones apart. This occurs in a large number of patients of which the following is a type.

A lady, thirty-six years of age, who has been under my care for the past fifteen years, has a space between the central incisors of .50 of an inch. No space was observed until she arrived at the age of twenty years. The teeth filled the arch and all antagonized. The lower jaw continued to delevop and the act of mastication carried the superior maxillary bone laterally widening the suture, the space filling in and producing quite a ridge (Fig. 120, Nos. 4, 5 and 6). The depth of the ridge depends upon the amount of irritation. The height of the groove

PLATE B.

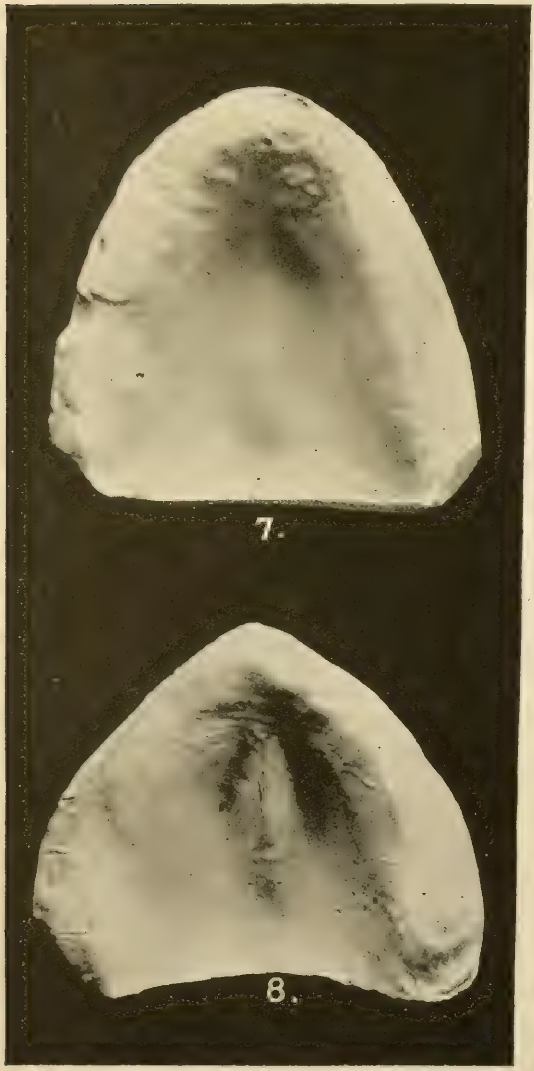


PLATE C.

on either side depends upon the depth of the ridge. When there are grooves upon either side the jaw is always contracted, the alveolar process being nearer the center of the vault. This, together with the ridges, produces the groove. Were it not for excessive development of the median suture and contracted arch, the vault would take the shape of the dotted lines and would be of normal development.

Deformed vaults are due (1) to an irregularity in the arrangement of the dental arch, (2) hypertrophy of the alveolar process and maxillary bones, and (3) to excessive development of the palatine suture. Irregularities of the dental arch are the result of (1) neurosis of development, producing arrest of development of the maxillary bone; (2) local causes accidental or otherwise. Those produced by an arrest of development take typical forms, classified under the heads of V, partial V, semi-V, saddle, partial saddle and semi-saddle. The irregularities of the teeth, produced by local causes, do not take typical forms, they are as numerous as the number of cases.

Hypertrophy of the alveolar process may affect the whole dental arch, or may attack one particular locality in which only one, two or three teeth may be involved. The shape of the vault in such cases depends entirely upon the extent of the hypertrophy, but does not take the typical form. The position, occupied by the teeth in the dental arch, and the manner of their formation should be studied under their respective heads. The deformed vault should be compared with the normal vault. For this purpose I secured models from dental practitioners in Chicago, consisting of six V-shaped (Plates 29 and 30), six semi-V (Plates 31 and 32), six saddle (Plates 33 and 34), and six semi-saddle-shaped (Plates 35 and 36). These were prepared in the same manner as the other models.

The direction of the teeth in a normal jaw are nearly perpendicular, while those in the V-shaped vault are at an angle of 45 degrees. This is due to the forward movement of the incisor teeth. Just back of the incisor teeth there is a prominent ridge of alveolar process (noticed in the normal jaw), is due to contraction of the vault in the anterior portion, producing thickening of the alveolar process. In other respects the vault does

PLATE D.

11.

12.

not differ from the normal palates. The same general rule holds good in the semi-V vault, except that the teeth do not stand at such an angle. This is due to the fact that frequently but one incisor protrudes, hence, one incisor only extends, while the other is perpendicular. The position of the normal tooth may be on the side of the model reproduced in this illustration. In the illustrations showing a cross section of the vault, the vaults are usually much narrower than in the normal. The two sides of the vault are not in harmony. These illustrations were very accurately made, so that by placing a rule at the center of the upper and lower arches, and drawing a line from one to the other, the two sides of the vault can be easily studied. The more contracted the jaw, the higher the vault and more irregular the sides. In the saddle and semi-saddle antero-posterior illustrations the teeth stand perpendicularly, hence, do not protrude. The ridge, posterior to the incisors is not so thick or prominent. The lateral illustrations do not show the pinched condition at the upper part of the vault that is noticed in the V-shaped vaults. This is due to the fact that the contraction is not in the anterior part of the mouth, but at the bicuspid region, while the bicuspids are carried in. The top of the vault is rarely ever affected. Occasionally alveolar process hypertrophy is so extensive that the teeth are carried laterally toward the median line, the vault is very much narrower and sometimes almost closed.

Local irregularities of the teeth may affect only the margins of the vaults and not the vault proper, since but few teeth are ever involved. The remainder of the dental arch, being, as a rule, normal, the vault proper is retained in its natural shape.

CHAPTER XXIV.

DEVELOPMENTAL NEUROSES OF THE PALATE.

As soon as the external nares are separated from the mouth a partition forms between the nasal pits and the mouth. This partition in which the intermaxillary bone is differentiated later is supplemented by another partition (the true palate), which shuts off the upper part of the oral cavity from the lower, thus adding the upper part to the nasal chambers. The palate is a secondary structure which divides the mouth into an upper respiratory passage and a lower lingual or digestive passage. The palate arises as two shelf-like growths on the inner side of each maxillary process. It is completed by union of the two shelves in the median line. The shelves arch so as to descend a certain distance into the pharynx, but in the pharynx their growth is arrested, though they may be still recognized in the adult. In the region of the tongue which includes more than the primitive oral cavity, the palate shelves continue growing.

At first they project obliquely downward toward the floor of the mouth and the tongue rises high between them and appears in sections which pass through the internal nares to be about to join the internasal septum. As the lower jaw grows the floor of the mouth is lowered and the tongue is thereby brought further away from the internasal septum. At the same time the palate shelves take a more horizontal position and pass toward one another above the tongue and below the nasal septum and meet in the middle line where they unite. From their original position the shelves necessarily meet in front (toward the lips) first and then unite behind (toward the pharynx) later. In the human embryo the union begins at eight weeks and at nine weeks is completed for the region of the future hard palate, and by eleven weeks is usually completed for the soft palate also. The palate shelves extend back across the second and third branchial arches; by the migration of the first gill pouch or in other words of the Eustachian tube, the Eustachian opening

comes to lie above the palate (uvula), while the second cleft remains lower down and lies below the palate as the anlage of the tonsil. The uvula appears during the latter half of the third month as a projection of the border of the soft palate. Soon after the two palatal shelves have united with one another the nasal septum unites with the palate also, and thereby the permanent or adult relations of the cavities are established.[1]

According to Beaunis and Bouchard the related development of the surrounding parts occurs as follows: "Beginning of third week—first pharyngeal arch; buccal depression. End of third week, coalescence of the inferior maxillary protuberances; formation of the three last pharyngeal arches. Fourth week—olfactory fossæ. Fifth week—ossification of lower jaw. Sixth week—the pharyngeal clefts disappear; the tongue, the larynx and germs of teeth. Seventh week—points of ossification of intermaxillary bone; palate and upper jaw (its first four points). Eighth week—the two halves of the bony palate unite. Ninth week—osseous nuclei of vomer and malar bone; the union of the hard palate is completed. Third month—points of ossification for the sphenoid and nasal bones; squamous portion of temporal; orbital center of superior maxillary bone; commencement of formation of maxillary sinus; epiglottis. Fifth month—osseous points of lateral masses of ethmoid; ossification of germs of teeth; appearance of germs of permanent teeth."

It will be obvious that any maternal factor (whether arising during a particular pregnancy or hereditary) may so check the development of the palate as to produce the various types of deficiency which are observed by surgeons.[2] Cleft palates are comparatively rare in proportion to other forms of nutritive degeneracy. As just pointed out palatal embryology casts a certain light on the etiology. Since most cases of cleft palate occur in defective individuals, and since cleft palate predisposes to death by infectious diseases whose local manifestations are in the mouth and throat, defectives in whom cleft palate most occurs are liable to die before the completion of their fifth year.

Cleft palate was much discussed by early writers. Early in

[1] Minot Embryology.

[2] Keen's American System of Surgery, page 639.

the nineteenth century Tiedemann[3] noticed in certain cases of cleft palate that the olfactory nerve was absent or abnormal. He concluded therefrom the deformity was resultant upon atrophy of nervous origin of the olfactory organ. This theory, however, failed to meet much acceptance. M. J. Weber, after a careful analysis of all accessible cases, failed to find one in which the olfactory nerve was absent. The coincidence of cleft palate and olfactory nerve atrophy discovered by Tiedemann probably resulted from the same central nervous maldevelopment. They bore no casual relation to each other.

The failure from various causes of the ultimate coalescence of the structures described by Minot leads to certain deformities the chief of which are cleft palate and harelip. Cleft palate, according to Bland Sutton,[4] has been known to affect several members of the same family and to occur in the offspring of the affected members. There are instances of the transmission of this deformity from an affected pug-bitch to her offspring. If it were possible to practice selective breeding in man as in dogs, a race of men with hare-lips and cleft palates could be produced.

Engle refers cleft palate to excessive development of the anterior portion of the brain and skull, such as produces hernia cerebri, ventricular atrophy or excessive anterior cerebral lobe development. This mixed patho-teratologic theory is not warranted by either embryology or clinical observation. The narrow and broad foreheads are alike affected.

Langdon Down, who has found a constant relation between brain deformity, cleft palate and deformed vaults, states: "The cause of the frequent excessive vaulting of the palate is not quite clear. It may possibly arise, as has been suggested, from sphenoid arrest of development or vomer defects in development." It has been plausibly shown that contracted high vault is not due to these conditions, and there can be no relation between contracted vaults and cleft palates. The cleft occurs before the tenth week of fœtal life, while the contracted vault does not appear until after the sixth year. The claim was made by Wal-

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[3] Zeitschrift f. Phys., Band 1, Heft 1, 1844, p. 71.

[4] Evolution and Disease, page 189.

ther[5] and Langenbuch[6] that cleft palate was becoming more frequent during the present century. This opinion was supported by Oakley Coles[7] on the ground that palatal vault deformities are more frequent and that a relationship existed between these and cleft palate. That the relation between a high state of civilization and a high proportion of palatal deformities is something more than a mere matter of coincidence. Coles, in dealing with the influences of civilization, ignores all but its supposed degenerative influence. Under civilization the defective classes are preserved. Furthermore, this preservation extends particularly to those under five years of age who would be destroyed under primitive conditions.

Early literature on this subject is admittedly meager. Early teratologists discussed the gross rather than the minute details, and registration of cleft palates was neglected in common with brain, renal, hepatic and cardiac teratology.

Cleft palate may divided into two classes—congenital and acquired. Congenital cleft palate is meant existing at birth. Acquired cleft palate is the result of disease, inherited or acquired, but affecting the part after birth. Better acquaintance with disease etiology and its effects upon the hard palate shows causes of congenital lesions and effects of acquired disease upon the tissues to be at least allied.

Congenital cleft palate is divisible into two kinds—complete and partial; complete, when the fissure extends the entire length from the uvula to and including the anterior alveolar process and even the lips; partial, when only a small part of the structure is involved. Thus the cleft may extend through the anterior alveolar process involving only the incisive bones, which is very rare; when present, single or double harelip almost invariably co-exists. Cases occur where a small portion of the anterior alveolar process and jaw was involved with one or two teeth. The hard palate only may be involved to the extent of a small fissure, or the whole palate may be wanting. The soft palate only may contain the cleft or simply the uvula. Cases are on

[5] Graefe and Walther's Zeitschrift, Band 21, Heft 2, 1834, page 175.

[6] Neue Bibliothek f. die Chir., Band 4, Heft 3, page 492.

[7] Coles: Deformities of the Mouth.

record in which the non-development of the intermaxillary bones produces fissures in the lip.

A priori cleft palate would seem to be a direct expression of heredity. This view is taken by Bland Sutton[8] from actual observation. According to Oakley Coles,[9] "the antecedent which strikes one a priori, as being likely to play the most important part in the production of congenital deformities, is that of hereditary influence. But though it will be evident from the facts which I shall presently adduce that the direct influence of heredity in the production of cleft palate is marked and undeniable, no sufficient statistics have as yet been brought forward to show that the actual presence of the deformity in the parent has any direct predisposing influence in the child. In other words, though the defective conditions which precede and accompany the phenomenon of cleft palate are almost certainly to be referred to parental influence it is extremely doubtful whether cleft palate is in itself transmissible." Demarquay, Roux, Trelat, Follin and Duplay are inclined to an opposite belief and their conclusion is supported by the evidence in connection with the analogous deformity of harelip. Still, unless accurate records of ancestry could be obtained for three or four degrees of removal, it would be premature to make any positive assertion on the point. However, it may be confidently stated the deformity is not usually produced from impressions received by the mother during pregnancy. In most of the cases which have come immediately under my notice, where one of the parents had a cleft palate, all the children have been born perfectly developed, even though dread of transmitting the deformity was always present in the mind of the mother. In one case, curiously enough, there are three members of one family with cleft palate, one seventeen years of age, the other thirty and the third thirty-five; the first and last are ladies, the other a gentleman who is married and has a family without any trace of the father's deformity. In these cases no instance of cleft palate could be found either among the ancestors or the collateral branches of the family.

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[8] Op. Cit.

[9] Deformities of the Mouth.

In another family, I have obtained the following remarkable history: G. H. C., born 1853; perfect. L. C., born 1855; single harelip and cleft palate. J. F. C., born 1856; perfect. F. W. C., born 1860; double harelip and cleft palate. H. E. C., born 1863; perfect. The paternal grandmother also had cleft palate.

Knecht[10] found five per cent of 1,200 criminals examined to have cleft palates and fourteen per cent of the prostitutes examined by Pauline Tarnowsky[11] had cleft palates. Langdon Down, among congenital idiots, found only a half per cent of cleft palates. Grenser only found nine cases in 14,466 children, or one in 1,607. I examined 1,977 feeble-minded children without finding a single case. In 207 blind, but one case was observed. In 1,935 deaf mutes two cases, or about one in 1,000. The percentage among the defective classes is undoubtedly much larger than among normal individuals, but early deaths explain the small numbers.

Bland Sutton's experiments with dogs indicate not only the presence of this deformity among animals, but the fact that it is transmitted. The influence of heredity is shown by the statistics of zoologic gardens. A keeper of the Zoologic Gardens in Philadelphia observed cleft palates in the mouths of lion cubs born in the gardens. Cleft palates were also observed in a number of pups born in Buffalo.

Ogle found that ninety-nine per cent of the lion cubs born in the London Zoologic Gardens had cleft palates. This he ascribes to the artificial diet as the result of enforced captivity. Similar results in other gardens in Europe were charged to feeding the mother with meat without bone, since feeding with the whole carcass of small animals greatly diminished these deformities. If cleft palate were sometimes attributable to this cause, other bony structures should likewise be involved. It is, hence, not astonishing to find many lions born in captivity were rickety. Cleft palate has been observed among dogs, sheep, goats, etc. The question, however, whether domesticity does not play in them the alleged part of civilization in man, can be solved only by knowledge of the frequency of the condition among wild

[10] Cited by Lombroso, Criminal Man.

[11] Etudes Anthropometriques, Op. Cit.

animals of the same family. In dealing with etiology the influence of shock on the mother's nervous system cannot be excluded in the cases charged to feeding.

The palate, it will be remembered, is partly of bone and partly of flesh. The fleshy part ends in what is called the uvula, which is very subject to abnormalities. As has been pointed out by C. L. Dana, uvula abnormality is very frequent in degenerates. Charles Dickens long ago noticed a uvular tone of voice in young thieves.

CHAPTER XXV.

DEVELOPMENTAL NEUROSES IN TEETH POSITION.

Arrest of development is confined mostly to the upper jaw; hence V and saddle-shaped arches are more numerous than irregularities of the lower jaw. Local conditions, such as premature extraction of the temporary teeth, causing the first permanent molars to move forward, thus diminishing the size of the jaw, are causes of irregularities.

The manner of these formations is as varied as the peculiarities themselves.

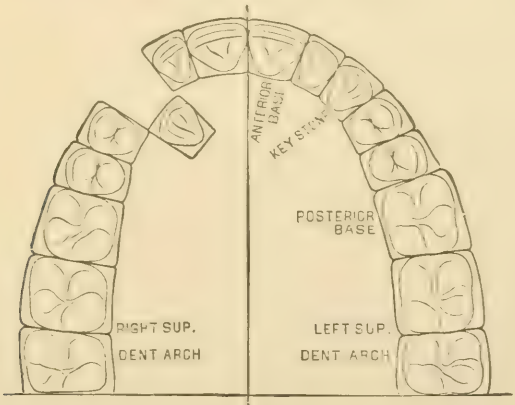


Fig. 121.

The only structures involved in the formation of these deformities are the jaws and alveolar process on the one hand and the teeth upon the other. The alveolar process is soft and yielding, while the teeth and jaws are composed of hard, unyielding substances. The process adapts itself to the conformation of the teeth. The teeth of the superior and inferior maxilla constitute a dental arch and the first permanent molars perform the function of keys to the arch. The jaws and teeth, like the lateral halves of the body, develop independently of each other, each possessing peculiar characteristics as regards irregularities

of the teeth. To simplify classification of irregularities of the teeth the lateral halves of the jaws, which are separated by the median line, will be denominated the right and left inferior and the right and left superior dental arches. While these terms, as applied to the lateral halves of the maxillary bones, are not strictly correct from an architectural point of view, still (as will be seen) they answer the purpose for which they are employed.

The manner of the formation of the V-shaped arch and kindred deformities may be compared to the construction of an arch. The changes which take place in the movement of the teeth are very similar to those which may occur in an arch of faulty

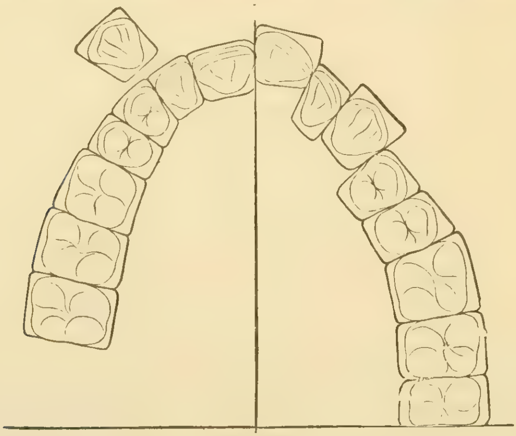


Fig. 122.

construction. Figs. 121, 122 and 123 represent one normal arch and five varieties of irregularities of the teeth. Each lateral arch is viewed as containing stones corresponding in number and size with the teeth of a normal upper denture. Fig. 121 represents two arches. The left superior arch is perfect. The first stone is marked "posterior base" and corresponds to the first permanent molar. The second stone is the "anterior base;" it corresponds to the central incisor. The next stone is located upon the anterior base and corresponds to the lateral incisor. The succeeding stones are laid upon the posterior base and represent the first and second bicuspids. The stone corresponding to the first bicuspid is usually in position first, but some-

times the stone corresponding to the second bicuspid is placed first. To complete the arch it is necessary to place the "key-stone" in position—the cuspid tooth. If the stones have proper proportions and measurements be correct, the key-stone will fit into place and the arch will be complete. On examining the foundations, two more stones are found, which correspond with the second and third molars; these stones with the base and the stones above the base making a strong abutment.

In order that aberrations from the normal may be understood a normal arch must first be adopted as a standard.

There are three characteristics of the normal arch. Inde-

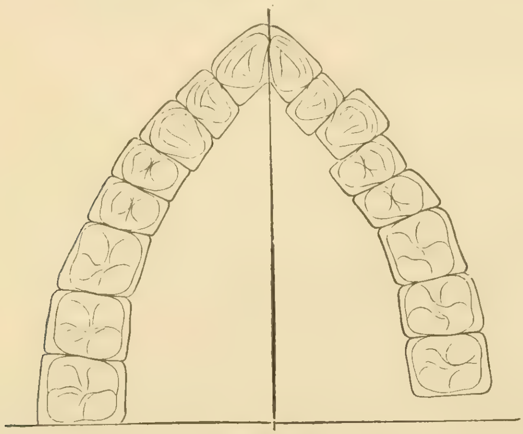


Fig. 123.

pendent of temperamental peculiarities, the line extending from one cuspid to another should be an arc of a circle, not an angle or straight line; the lines from the cuspids to the third molar should be straight, curving neither in nor out, the sides not approximating parallel lines. Absolute bilateral uniformity is not implied in this since the two sides of the human jaw are rarely if ever wholly alike. A uniform arch necessitates uniformity of development between the arch of the maxilla and the arch of the teeth and a correct relation of the individual teeth to each other. When there is inharmony of development between the jaw and the teeth, as may happen when one parent has a small maxilla with correspondingly small teeth and the

other a large one with correspondingly large teeth, if the child inherit the jaw of one and the teeth of the other, irregularities must occur. Such difference in diameter between the arch of the maxilla and that of the crowns of the teeth is a constitutional cause of irregularity.

Whenever there is a difference between these diameters, the line formed by the teeth must either fall outside or within the arch of the maxilla and irregularities of arrangement must result.

In Fig. 121, in the right superior arch, the diameter of the stones is either too small for the curve of the arch or the bases are set too far apart. This results in a greater space for the key-stone than is required; not finding support, it drops through toward the center line.

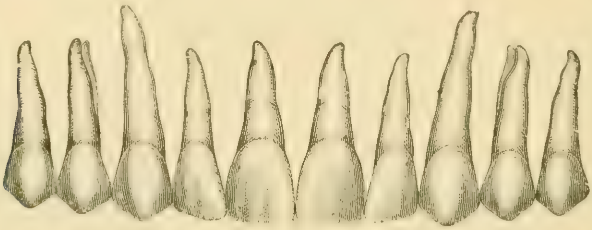


Fig. 124.

In Fig. 122, in the right superior arch, the posterior base and the foundation stones have been brought forward to such an extent that when the other stones are placed in position, the space intended for the key-stone is closed and the key-stone remains outside. The key-stone appears too heavy for the left superior arch and its weight has carried the smaller stones with it. The posterior base with its foundation stones being the strongest, resists the force; the anterior base being weak and without support, bulges out and in this way a semi-V-shaped arch is produced.

In Fig. 123 the key-stone has gradually carried the right superior arch inward; the posterior base is in its proper position, the anterior base has been carried forward and all the stones are in line. The key-stone in the left superior arch has produced the same result as upon the opposite side, excepting that the posterior base and the foundation stones were placed too far

forward, leaving insufficient space for the key-stone. The teeth, however, do not bear the same relation to each other upon their approximal surfaces that the stones of the arches do. The stones of an arch have broad flat surfaces, while the teeth merely touch upon the points of rounded surfaces.

The ten anterior teeth, which are involved in the construction of the V-shaped and kindred irregularities, are illustrated in Fig. 124, in which the positions of the roots and crowns and their mutual relations are approximately shown. As will be observed, the teeth are all wedge-shaped, the bases being located near the cutting and grinding-edges and the apices at the ends of the roots. These are nearly round and conical, the points of antagonism being near or quite at the cutting edge or grinding edges. Fig. 125 shows a section of the teeth at their points of contact. These points must be kept in mind, as they constitute the fulcra of the levers, which, when force is applied to the teeth, cause them to rotate and move out of position, thus producing more varieties of deformities than it is possible to demonstrate upon the stone arch.

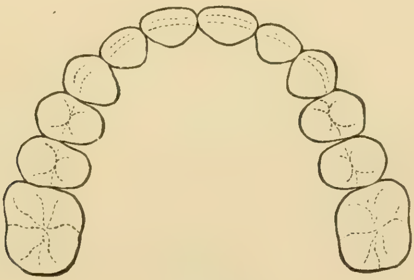


Fig. 125.

These irregularities are not observed until after the eruption of the second set of teeth. The first permanent molars are largest, strongest and possess largest roots of any teeth. They are located posteriorly to the temporary set. Owing to their position and to their long, large roots, their apices are directed backward. In a majority of cases, the distance from the apex of one root to that of another is greater than at the neck, which indicates that they are firmly fixed in their alveoli. The alveolar

process is wide at those points, hence these teeth may be designated as the posterior basis of the lateral arches.

The next teeth which make their appearance are the central incisors. These are situated in the extreme anterior alveolar process on either side of the median line. The process is quite thin at these points. These teeth will be called the anterior bases of the lateral arches. The next to make their appearance are the lateral incisors, which take positions at the distal surfaces of the central incisors. The roots of these teeth are not so large nor so long as the roots of the centrals, hence they are not as firmly fixed in the alveoli. Each lateral tooth, however, is supported by the central and represents the second stone upon

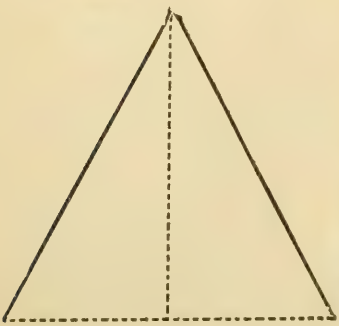


Fig. 126.

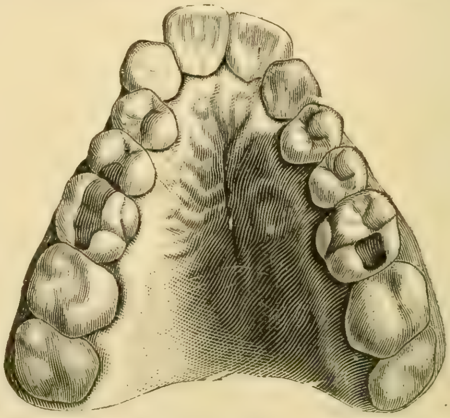


Fig. 127.

the anterior base. The teeth which appear are the first bicuspids. Immediately following are the second bicuspids, which represent the second and third stones upon the posterior bases. The arches are then complete, except the key-stones—the cuspid teeth. These cannot be omitted, for they bind and hold the teeth together and give beauty and shape to the arches. The follicles of these teeth are originally situated outside of and above the crown and roots of the teeth already in the arch, which results in a larger circle, and because these teeth have long, powerful roots, unusual power and leverage is given them. For this reason they are directed downward and inward, their crowns being so located that the lips assist greatly in aiding the down-

ward movement of these teeth. The downward and inward movement of the cuspids is similar to the lowering of the key-stone in an arch. It continues to move downward until it meets with an obstruction, which may be confined to the upper jaw and include the teeth anterior and posterior to the cuspid. If the teeth in position be in harmony with the jaw, the cuspids will descend into their proper places and, touching the teeth on each side, lock the arches and hold the teeth in proper position.

In the posterior parts of the mouth the alveolar process is very thick and the base—the first permanent molar—is large, having three roots in the upper and two in the lower jaw,

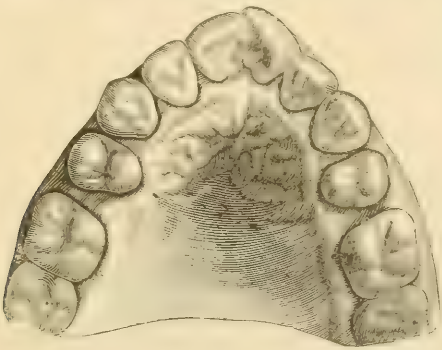


Fig. 128.

curved and so arranged in the alveolar process as to preclude its going backward. Other teeth of nearly equal strength are found posterior to the first permanent molars. Anterior to the base—the first permanent molar—the first and second bicuspids are found. These teeth are all firmly imbedded and situated in the long axis of the alveolar process, forming together a very firm base. The anterior column of the arch consists of but two teeth, while the posterior column has five. The anterior teeth possess single roots and are situated crosswise in a very thin alveolar process, hence the comparative weakness of the anterior arch. In some intances the space may be too large in the superior arch and the key-stone or cuspid tooth may continue in its downward course till it engages with the teeth in the lower jaw.

The V-shaped arch presents a triangular outline (Fig. 126), the apex of the triangle being formed by the central incisors, where the process is usually bent so that the incisors form an angle instead of being in line. From this apex the lateral halves are in a straight line, terminating at the first molars; a line connecting them forms the base of the triangle. The cause of this peculiar outline is a want of correspondence between the size of the jaw and teeth or the premature extraction of the temporary molar or both causes combined, thus allowing the first permanent molars to move forward. When the rest of the permanent teeth come in, they are crowded together. The process must give way in order to adapt the greater arch formed by the crowns of the teeth to the lesser arch of the maxilla. The

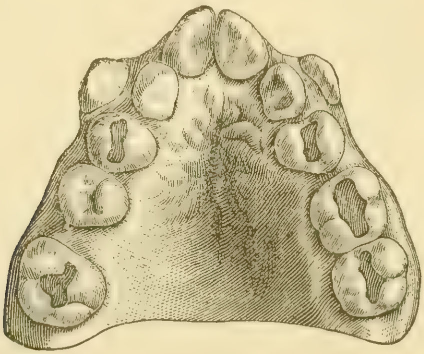


Fig. 129.

point of fracture is in or near the median line, since the process is thinnest at this point. The illustrations given here show varieties of this type. By comparing each one with the diagram it will be seen that they all are triangular in outline, Fig. 129 being the best representation of this form of irregularities. A line passing from the median line of the central incisors through the cutting edges and crowns is straight. Study of the cases here given will reveal the result of the forward movement of the first molar. The subsequent loss of teeth, the peculiarity of articulation and the thinness of the process at certain points determine the modifications. In Fig. 127 the laterals are gone; for the reason the centrals are still in line, space having been made by the absence of the laterals. In Fig. 128 it is evident

from its overlapping centrals that there was want of space at the time of their eruption; the loss of the second bicuspids subsequently have, together with peculiarities of articulation, permitted the lateral halves to assume some curvature. In Fig. 127 there is an arch too small for the teeth and is destitute of the right first molar and the left first bicuspid. These were evidently lost after the central incisors were erupted. The rest of the teeth have migrated more or less because not kept in place by close articulation. Thus the cuspids are kept out of place and by their pressure inward tend still more to narrow the arch anteriorly. In Fig. 130 the central is spread, though the process is evidently bent. This spreading is accounted for by the absence of right lateral, which has allowed the central

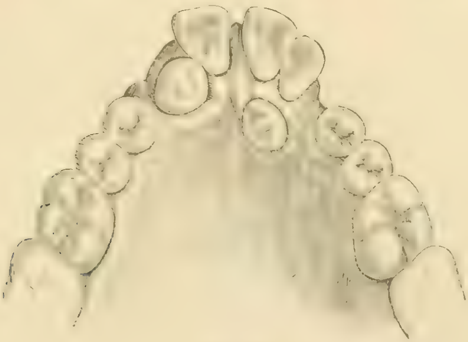


Fig. 130.

to move backward and the cuspid to move in. On the left side the cuspid has erupted inside of the arch.

Modifications of the V-shaped arch result from modifications of the above named conditions. A difference in the time of eruption of the cuspids, everything else being equal, effects a difference in the space left for their accommodation and thus partial V-shaped arches are found. The key-stone (the cuspid) is not entirely outside nor inside of the arch in the partial V-shaped form, but may appear partially crowded out of place. Hence the arch is neither a normal curve nor wholly angular, but unites the characteristics of both. Its lateral diameter is less than that of the normal arch, giving it a contracted appearance (Fig. 131). Thus a number of varieties of the funda-

mental forms of the V-shaped arch are formed, differing in degrees of anterior contraction. All of these result from the comparative thinness of the anterior portion of the process offering but little resistance, an abnormal pressure from behind and the greater strength of the cuspids, which causes them to seek room irrespective of the space left for them. By drawing a perpendicular line from the median line of the central incisors to the base and comparing the halves thus obtained with the diagram, the right half in Fig. 132 is seen to be partially V-shaped while the left is normal. Near the apex is the crowded condition of the incisor, overlapping the lateral; from thence back the curve of the arch is lost. The absence of the first bicuspid,

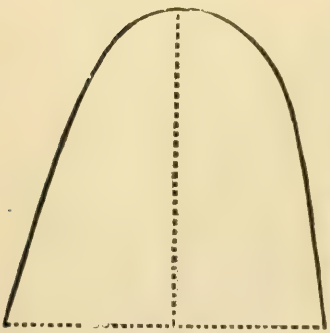


Fig. 131.

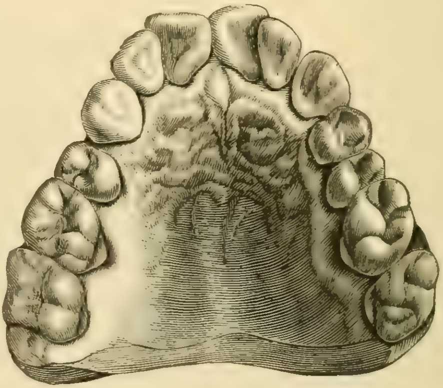


Fig. 132.

together with the want of proper articulation, has allowed the cuspid to press nearer the center of the palate than is normal.

In Fig. 133, the V-shape is not so apparent, but the central incisors are crowded, which shows that there is not perfect harmony betwen size of teeth and jaw. This contracts the anterior arch.

When one side of the process near the symphysis is the stronger, thus affording greater resistance or the pressure of the cuspid is less, that side may maintain its normal relations, while the other may give way to conditions resulting in a V-shaped contraction. The curve will then be broken, not at the apex of the triangle, but near it; the incisors will overlap

and when pressure from the cuspid acts on the weaker column it must give way. This results in the semi-V-shaped form. (Fig. 134.)

In Fig. 135 is a semi-V-shaped arch. The teeth in the left dental arch are nearly on a straight line. The teeth in the right dental arch are situated upon a slight curve. In this arch the cuspid is in position, while upon the left arch it is missing. The posterior teeth have moved forward and filled the space intended for the cuspid. It is still located in the alveolar process, but the force produced by the inward pressure of the cuspid is so great that the central and lateral incisors have been carried

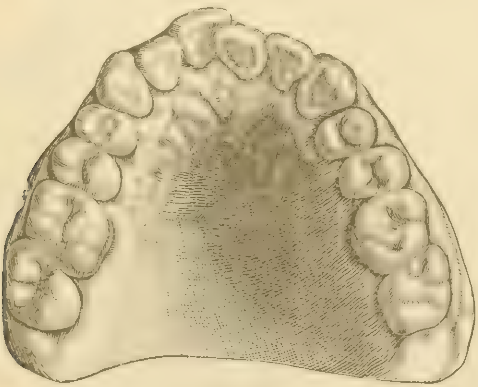


Fig. 133.

forward and the teeth and alveolar process have produced the straight line. The lateral pressure of the teeth prevents their being carried farther inward. The lack of proper antagonism of the central incisors has allowed the cuspid to force the incisor and alveolar process forward until the basilar ridge of the right central antagonizes with the mesial surface of the left central. This, in a measure, checks the progress of the cuspid inward and holds the arch on a slight curve. A perpendicular line drawn from the mesial surface of the right central incisor (Fig. 136) to the base shows the left side to be V-shaped, while the right is normal. In Fig. 137 the outline does not clearly point to a V-shaped arch. By comparing the curvature of the two halves and noting the position of the right cuspid, it is more

apparent. The bending of the process at the mesial line is evident from the position of the right central. This has turned upon its axis from want of lateral antagonism and proper occlusion. This partial rotation has allowed the lateral to move back, occupying in part the space of the cuspid, which has forced the cuspid out of its normal position, causing it to erupt outside of the arch.

Fig. 138 shows a combination of semi-V and partial V-shaped arches. The cuspid, being outside of the left arch, contracts it and gives it the characteristics of the V-shaped. On the right side the cuspid is partially crowded out of place and the arch is somewhat contracted.

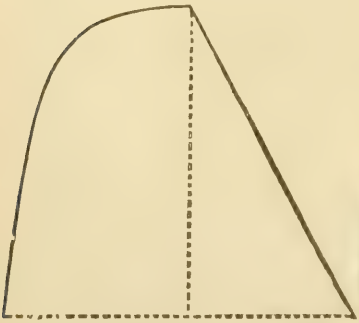


Fig. 134.

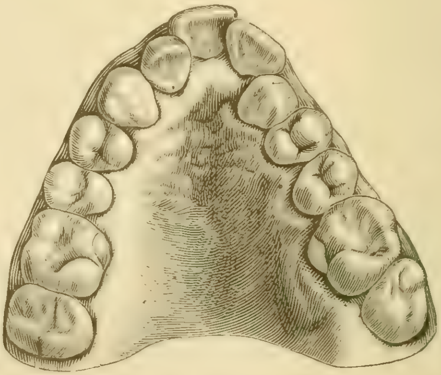


Fig. 135.

The lower jaw never assumes the V-shape when the teeth articulate normally, because the anterior inferior teeth normally close inside of the upper teeth, and, while the force from improper occlusion of the jaws and the forward movement of the posterior lower teeth is as great or greater than the like force exerted upon the upper jaw, the forward movement of the central incisors is prevented by striking their anterior surfaces against the posterior surfaces of the superior incisors. There are many irregularities of the anterior inferior teeth caused by the forward pressure of the posterior teeth. These are quite difficult to regulate, owing to their intimate relations with the superior incisors. The inferior dental arch should be divided into the right and left lateral arches, corresponding to those of the

superior arch. The pressure produced by improper articulation and the forward movement of the posterior columns (the bicuspids and molars) is exerted on each lateral half independently, like that in the lateral arches of the upper jaw. Each lateral

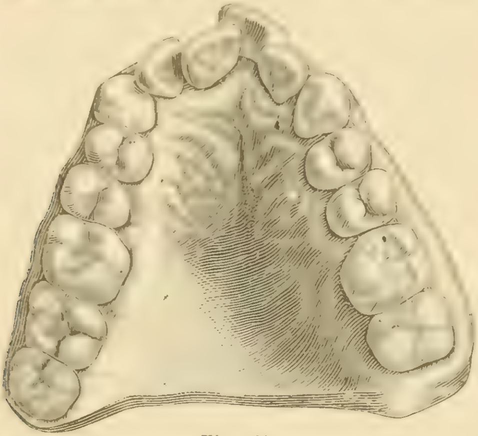


Fig. 136.

arch on the lower jaw has its posterior base (the first permanent molar), an anterior base (the central incisor) and the same number of stones in position upon the bases—the same key-stone—

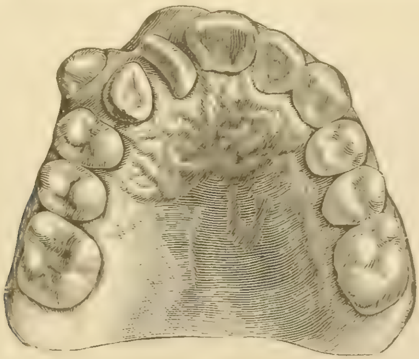


Fig. 137.

all representing the same number of teeth as are contained in the superior lateral arches. The development of each inferior lateral arch is independent of the other, as is the case with the superior lateral arches. The irregularities of the teeth in

each lateral arch are independent of the others. When the posterior column moves forward, if the key-stone (the cuspid tooth) is retarded or slow in coming into place, the space is filled by the first bicuspid and the cuspid remains outside, precisely as in the superior lateral arches. If the pressure of the posterior

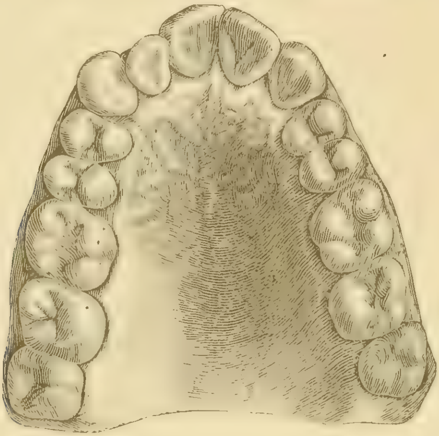


Fig. 138.

columns and the key-stone be uniform, the force will be exerted against the anterior base and the first stone upon the base (the central and lateral incisor). In this case a different condition exists. The anterior base and first stone of the superior lateral arch and the anterior inferior column, resist the force. Occa-

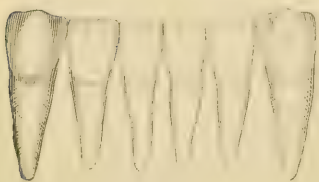


Fig. 139.

Fig. 140.

sionally, this is so great that the anterior columns of both superior and inferior dental arches are carried forward. When this occurs, the incisors upon the upper jaw protrude. When the forward movement of the posterior column occurs, the incisor (or anterior column) will crowd past one another like

the sticks of a fan, provided the pressure be uniform in both lateral arches. The six teeth which are instrumental in the construction of these deformities are illustrated in Fig. 139. These teeth, as will be observed, are wedge-shaped; their points of

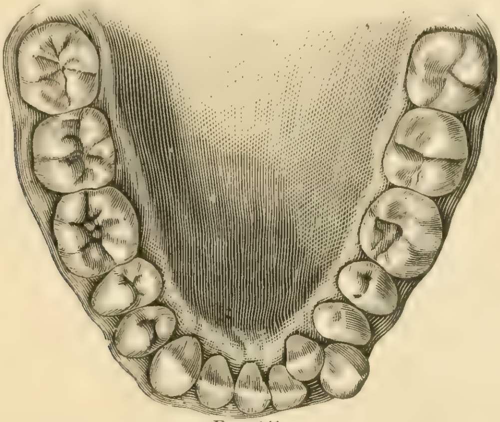


Fig. 141.

contact are at their cutting edges; slight oblique pressure will cause these teeth to lap over each other. If the pressure is upon one side only, the irregularity will be located on that side. One of the common irregularities is seen when the key-stone

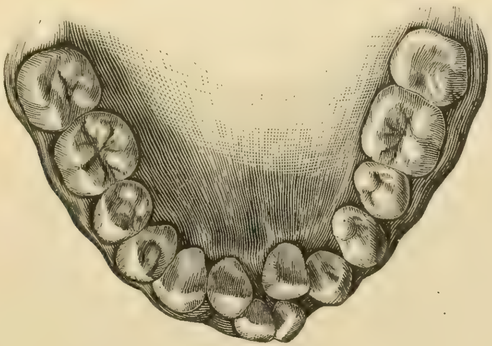


Fig. 142.

or cuspid tooth is slow in erupting. The posterior column moves forward and the resistance of the anterior column forces the key-stone outside the arch. It sometimes happens that the key-stone moves into place and is held in position by the anterior

column and the second stone upon the posterior column (the first bicuspid) is carried forward outside the arch. This can be better understood by examining cases of this kind, which will be illustrated later. In Fig. 140 is seen in position a section of the

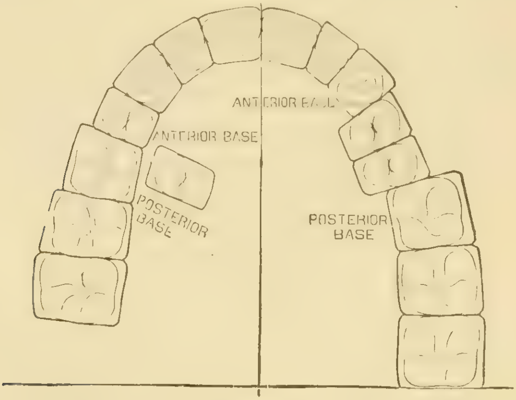


Fig. 143.

teeth made on the line of lateral antagonism. The mesial and distal surfaces are convex and the points of contact are situated at the extreme lateral surfaces. If the teeth at eruption should not touch at these particular points, or if the force exerted

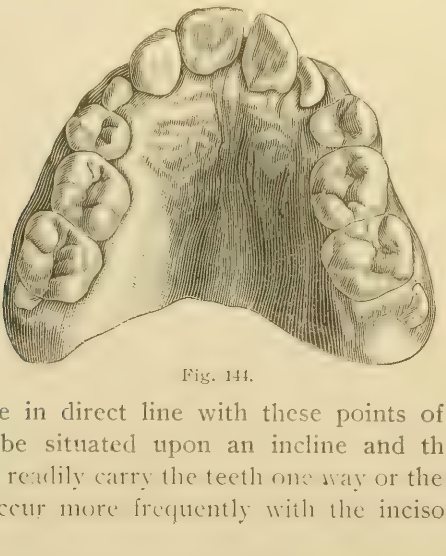


Fig. 144.

should not be in direct line with these points of contact, the teeth would be situated upon an incline and the force thus applied would readily carry the teeth one way or the other. Such deformities occur more frequently with the incisor and cuspid

than with the posterior teeth. The posterior teeth are held in position by their contact with the occluding teeth of the opposite jaw, while the incisors do not occlude. One marked feature of these irregularities is that in most cases the lateral incisor is carried inward and the centrals outward to remain in position in one or both lateral arches. These conditions are fully illustrated in the chapter on local causes. In Fig. 141 the right dental arch is normal. In the left dental arch the anterior column with the cuspid (the key-stone) has moved forward and the lateral incisor is carried inward. This is explained when the relation between the mesial surface of the cuspid and the distal surface of the lateral is understood. In the forward move-

Fig. 145.

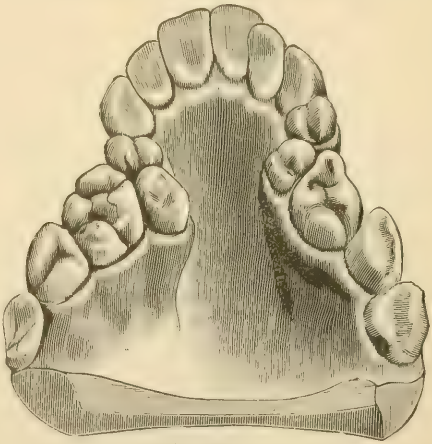


Fig. 146.

ment of the cuspid the lateral impinges upon a markedly inclined plane upon the mesial surface of the cuspid and the forward pressure carries the lateral inward. In Fig. 142 is the same irregularity in both right and left lateral arches, the pressure being uniform upon each arch. The centrals are also slightly rotated in their sockets. This is produced by the flat lateral surfaces of the roots meeting and the pressure of the crowns against the basilar ridges of the superior centrals.

The saddle-shaped arch is not so common a deformity as the V-shaped. It has many peculiarities, however, that are seen in the V-shaped. It may include one or both lateral arches. It may

be partial on one side and marked on the other. It may involve the bicuspids and first permanent molars upon one side or but a single tooth on the other. Each lateral arch produces its own deformity independently of the other. The roof of the mouth may be high or low. The deformity, like the V-shaped, is

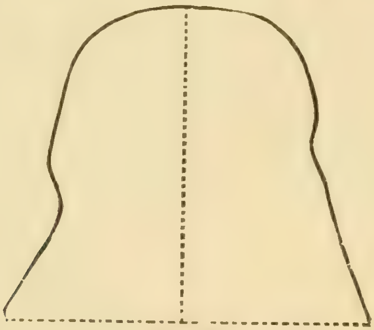


Fig. 147.

favored by the high arch. In Fig. 143 is seen the manner of production of this deformity. Here is a right and left superior lateral arch of stone, each stone corresponding in size and location to the natural teeth. The left lateral stone arch, corre-

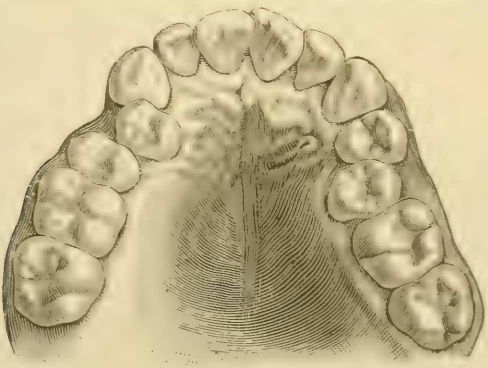


Fig. 148.

sponding to the left superior dental arch, shows the formation of the saddle-shaped arch and order of laying the stones and changing the base. The first stone laid in the arch corresponds to the first permanent molar, and, like the stone in the V-shaped arch, is denominated the posterior base. The next stone laid

corresponds to the central incisor, then the stone which stands for the lateral incisor. The natural order then changes and the next stone laid corresponds to the key-stone of the V-shaped arch (the cuspid). It becomes the anterior base forming a fixed point in the anterior part of the mouth. The next stone laid corresponds to the first bicuspid, followed by those representing the second bicuspid and the second and third molars. The stones being in position, the anterior and posterior columns are nearly equal in strength and resisting power. The anterior column is made up of the anterior base (the cuspid) with its long root, backed up by two foundation stones representing the central and lateral incisors. The posterior column is made up

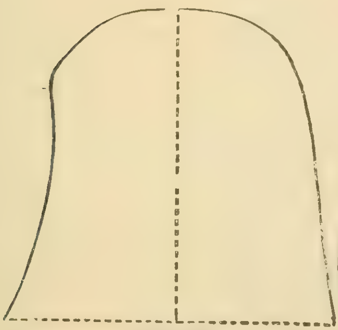


Fig. 149.

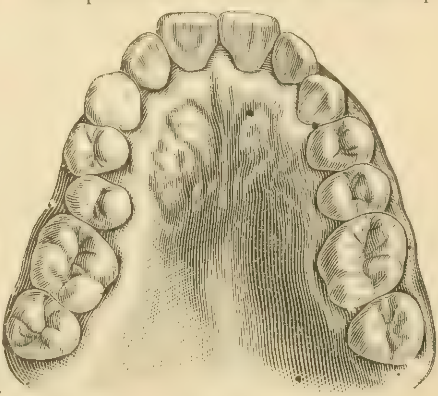


Fig. 150.

of its base, the first permanent molar backed by two foundation-stones representing the second and third molars. The forward movement of the posterior column takes place in the arch from the same causes which produce the forward movement in the V-shaped arch. The stone representing the cuspid is not the stone involved; it is always fixed in its proper place. The weaker stones are those which correspond to the bicuspids and they are the stones which are always displaced when the forward movement of the posterior column occurs. The change in the order of the laying of the stones—i. e., the stones corresponding to the cuspid instead of the bicuspid (it being irregular)—accounts for there being fewer saddle than V-shaped arches. The change of the anterior base will also explain why the anterior column

and alveolar process do not project, as in the case of the V-shaped arch. The right superior lateral arch illustrates another common variety of the saddle-shaped arch. It does not differ materially from the left lateral arch as regards the order of laying the stones. The anterior base is transferred one stone back, the stone corresponding to the first bicuspid. The posterior base remains the same. The posterior column moves forward and carries the stone representing the second bicuspid inward. On comparing the shapes of the natural teeth with the stones in the arch just described, it is found that the approximate surfaces are convex instead of flat like those of the stone arch just

Fig. 151.

described. The peculiar incline of the anterior surface of the first permanent molar and the posterior surface of the cuspid tooth, together with the oval shapes of the bicuspids, are singularly well adapted to cause these irregularities upon the application of force. The first permanent molars are situated farther outside in the arch than any teeth posterior to them. The cuspids occupying such a prominent position in the arch in the anterior part of the mouth, the least deviation inward of the bicuspids would give the pinched appearance of the jaw at that locality. In neurotics and degenerates the jaws will in some cases develop in length and not in width. In such cases the jaws at the sixth and seventh year remain permanent. The

temporary molars hold the permanent bicuspids in the undeveloped position and the cuspids erupt outside the arch. In this way a full saddle is formed. This deformity is caused also by the too early extraction of the temporary molars, which allows the first permanent molars to work forward and force the bicuspids inward, or by the retention of the temporary molars or their roots, thus deflecting the crowns of the bicuspids. The question arises, why are not the bicuspids forced outward as well as inward? They do occur frequently outside the arch. The inward movement, however, is the natural one, because the crowns when in the jaw are situated between the roots of the

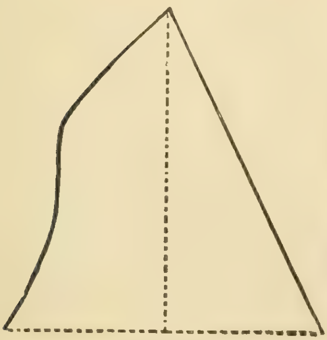


Fig. 152.

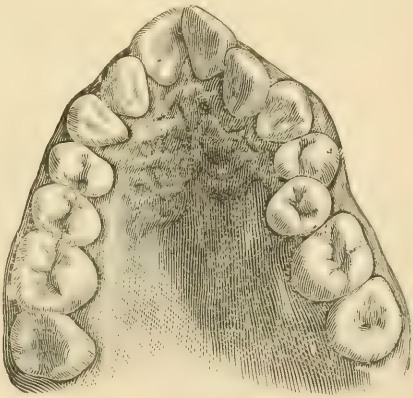


Fig. 153.

temporary molars. The temporary molars are situated upon a smaller circle than the permanent molars and cuspids (Fig. 144). When the temporary molars are extracted, the crowns of the bicuspids are in the radius of a smaller circle, while their roots have been carried outward by the development of the jaw and alveolar process.

The molars in the saddle and semi-saddle-shaped arches of the upper jaw frequently diverge laterally. If the case shows a semi-saddle-shaped arch, the divergence is on the side of the deformity. If both lateral arches are involved, both sides diverge. Cases having the deformity most prominently have the most marked divergence. When a slight change exists only at the bicuspid region, the divergence in the molar region is slight.

This peculiar arrangement of the molar teeth may be due to two causes: First, the teeth upon the lower jaw diverge on account of the shape of the inferior maxilla; the farther removed from the incisors, the greater the distance between the molars of the opposite side. The molars upon the upper jaw usually articulate with those upon the lower jaw. The disparity in the appearance of the normal position of the teeth and those above described is due to the pinched condition in the bicuspid and first molar region rather than to the position of the molars. Second, when the arch is contracted at the bicuspid region the tongue goes to the roof of the mouth and is then forced backward for lack of room, thus shortening and consequently broad-

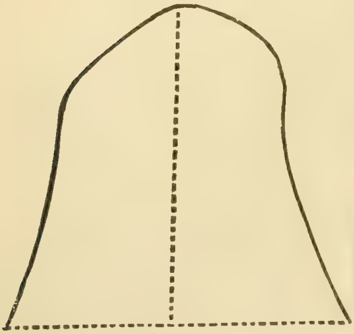


Fig. 154.

Fig. 155.

ening its surface. The result of the lateral expansion would naturally be to force the teeth and alveolar process outward.

The position of the temporary molars determines the position of the bicuspids. This position shows the diameter of the jaw early in life. From that time until the eruption of the third molar, i. e., from the third to the twentieth year, the jaw has no opportunity to develop, which naturally carries the alveolar process and teeth out laterally, causing the crowns of the third molar to face the cheek sometimes.

When there is harmony between the size of the teeth and that of the arch and the permanent bicuspids erupt under favorable conditions, so that their greatest diameter is in a line with the greatest diameter of both first cuspid and molar, they will

be held firmly in place, since the greatest pressure is on this very line. On the other hand, when the bicuspids are erupted after their proper time, while the cuspids progress duly, the cuspids, meeting with no resistance, fall into their natural position, while the bicuspids erupt inside of the arch, forming an angle. This angle results from two causes—thinness of the process at this point and diminution of resistance which must follow.

In Figs. 145 and 146 is seen a decidedly saddle-shaped arch. The maxillary bone is too narrow at its anterior extremity for the teeth, which are suited to a more expanded jaw. The constitutional tendency to this deformity is quite apparent in this case. The vault is high and narrow. The first molars are pushed

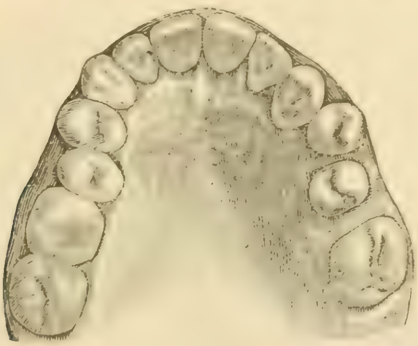


Fig. 156.

forward, leaving only sufficient space on each side for one bicuspid. These are, therefore, turned inward toward the palate, making the vault at this point still narrower than it naturally is.

When the unfavorable conditions that result in the saddle-shaped arch are not so pronounced we have the partial saddle-shaped arch (Fig. 147). Thus, because of the greater uniformity of the maxilla and of the crowns there may be more space and the bicuspids may be forced but little out of place, or the molar may move forward but slightly, interfering less with the bicuspids. Sometimes it happens that in trying to adjust themselves to the limited space one bicuspid may be crowded outward and another inward. Sometimes the first bicuspid is in, more frequently the second (Fig. 148).

In Figs. 149 and 150 are found a normal arch on the left side and a saddle-shaped arch on the right. The vault is normal in this case; hence there is more room for the erupting bicuspids and less curvature results than is found in Fig. 148. Fig. 151 shows a similar condition of the left side.

How the V and saddle-shaped arch may be combined on one side remains to be explained. Given thinness of process in the anterior part of the mouth, premature or tardy extraction of the first molar and there will be a forward movement of the incisors. The development of the cuspid will press the alveolar process inward, thereby contracting the arch and the tardily

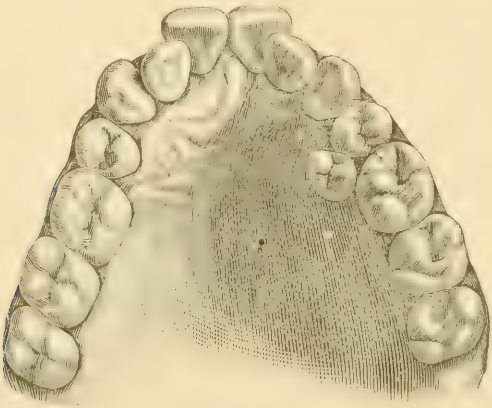


Fig. 157.

erupted bicuspids will adjust themselves to the limited curve as before stated. In this way the features of the two forms are combined; that is a contracted or angular anterior arch and a posterior arch more or less concave. The opposite side may be V-shaped, saddle-shaped or normal (Figs. 152 and 154).

In Fig. 153 occurs a combination of V and saddle-shaped arch on the left side and V-shaped on the right. In Figs. 154 and 155 is seen a case of semi-V and semi-saddle-shaped arches combined.

In Fig. 156 appears a semi-saddle-shape in the right lateral arch; the second biscuspid has been forced inside the arch. The opposite side shows a condition exactly reversed. The points of lateral antagonism of the second bicuspid are outside

the long diameter of the dental arch. The anterior movement of the posterior base forced the tooth outward. The tendency of this irregularity was to form the V-shaped variety. The irregularity of the left lateral arch (Fig. 157) is a common one. The teeth develop normally, but the second bicuspid is either retarded in development or deflected inward by a local cause. The anterior base is, in this case, transferred to the first bicuspid. The posterior and anterior bases come together, and the second bicuspid is crowded inward. The irregularity corresponds to the right lateral stone arch of Fig. 143.

The saddle-shaped arch on the lower jaw is generally due to

Fig. 158.

local causes, the retention of the temporary molars being one. The one illustrated is the result of both local and constitutional causes. This deformity is also due to an arrest of development of the lower jaw.

In Fig. 158 a saddle-shaped irregularity upon the lower jaw is observable. The impression is from the jaw of a man fifty-six years of age. The second molars were extracted at the age of twenty-two. The irregularity was produced at the time of development of the teeth. The teeth are large and firmly set in the powerful jaws. Asymmetry of the jaws exists. If they had developed in unison, this deformity would have been prevented. The forward movements of the posterior columns have carried the cuspids forward and the lateral incisors inward, so that the

cuspids and centrals stand on a line. The second bicuspids and first permanent molars have been forced inward by the inclined plane formed by the posterior surfaces of the first bicuspids and also by the articulation of the superior teeth, which form a smaller arch than the lower teeth. As will be seen, the third molars have moved forward and nearly filled the spaces made vacant by the extraction of the second molars. This forward movement was no doubt due to improper articulation with the upper teeth.

CHAPTER XXVI.

LOCAL CAUSES OF TEETH IRREGULARITIES—UPPER JAW.

Local irregularities are found in malposition and malocclusion of individual teeth, as a result of an accident (such as premature or tardy extraction of temporary teeth) or malposition and malocclusion resultant on constitutional causes.

Foremost in influence on the relative position of permanent teeth is the first molar. If the temporary molar be extracted prematurely, the forward movement of the posterior column follows it, the expanse of the anterior column producing more or less vicious position, relation and occlusion. The anterior move-

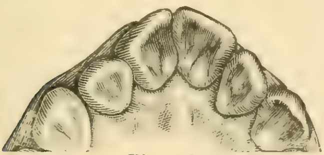


Fig. 159.

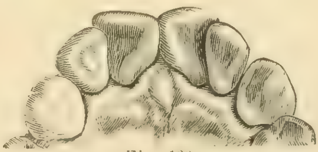


Fig. 160.

ment of the temporary molars and cuspids as well as the permanent bicuspids and cuspids from the great force exerted by the first permanent molar occurs the same. To this even the cuspid, though most influential in the anterior column, must yield. Next to the first permanent molar in importance is the cuspid. It asserts itself above the rest because of its vital force, length of root, peculiar shape and location in the jaw. The length of its roots allows it to be deviated most of any tooth from its original position, since with the same degree of pressure brought to bear on or near the apex of its root a tooth may diverge in proportion to the length of its roots. Though the angle be the same the divergence grows greater the farther the cusp is from the apex.

The central incisor comes next in importance and then the lateral. The central incisor finds a support in its fellow on the opposite side, while the lateral is the most passive of teeth. It,

however, plays the part of a co-ordinating force. Without this wedge the teeth would not be retained in their position and occlusion would be disturbed. Because of its weakness and short root it is very easily displaced.

In the chapter on general causes of irregularities the fact was emphasized that the forward movement of the posterior column, i. e., the bicuspids and molars, due to premature or tardy extraction, will force the weaker anterior column and

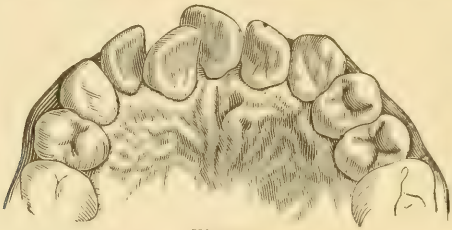


Fig. 161.

alveolar process forward. The pressure brought to bear upon it from both sides makes the arch of the upper maxilla greater than that of the lower. As a consequence occlusion will be wanting or defective and flexion must take place according to position assumed in the eruption of each individual tooth. This condition is greatly promoted by the pressure of the cuspids, which, in coming down, assert themselves at the expense of the

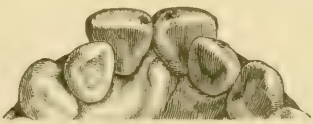


Fig. 162.

weaker incisors. But this is not all. Much depends on the size and the development of the germs of the permanent incisors. When there is strong vitality and they join in the struggle for existence between the organs, their growth may be out of proportion to that of the alveolar process. Owing to healthy nutrition or the nature of the food that is taken into the system during the time of their development the centrals may become very vigorous. This extraordinary development shows itself not so much in relative position of the axes as in irregularities of the

cutting edges. These, from their excessive diameters, overlap slightly. When a temporary incisor persists too long in its socket, the germ of the permanent tooth is embarrassed in its eruption. The germ seeks its way out as best it can and as projecting in a straight line is out of the question, it slips around the temporary teeth and is forced partially out of position. The process in this case is not unlike that of the germ of a plant that forces its way out from under a stone.

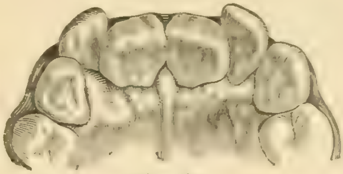


Fig. 163.

Having considered the cause of the irregularities of this division, the varieties must next attract attention. A form frequently met with is found in V-shaped arches. The central incisors are crowded together so that their cutting edges are not in a line, but form an angle that points forward (Fig. 159). This is the most natural form for the flexion to assume. The arch is simply broken in front, following the general direction of the

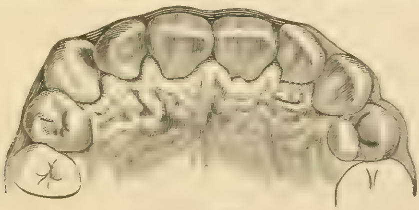


Fig. 164.

pressure. The mesial surfaces are parallel; the anterior angle points forward, following the general law of the incisors. The force is uniform. Had the anterior column not been forced forward by the posterior one, these teeth would be normal in every respect. Sometimes they overlap slightly. Occasionally general axes of the teeth do not converge, but diverge. This is due to faulty occlusion, the lower incisors acting as a wedge, driving the upper incisors apart or from want of occlusion, they follow their course without guidance and support.

In the second class, where the cutting edges form an angle, which is directed backward (Fig. 160), the pressure from behind by the posterior column has met with an obstruction in front. This obstruction exists in the center of the alveolar process and is strong enough to resist in a measure the pressure from behind. Hence the force spreads itself on the lateral divisions of the anterior process. The result is that the mesial line is formed behind the distal line and an angle is formed. Here, as in the former case, occlusion is an important factor in determining the position of the axis. A want of proper occlusion may force the anterior teeth apart. The laterals also, in seeking their natural position, may help to force the distal surfaces of the central incisors still more out of place. Being wedged in between centrals and the cuspid teeth, the latter, by their great force, cause the centrals to yield to the laterals that are wedged between

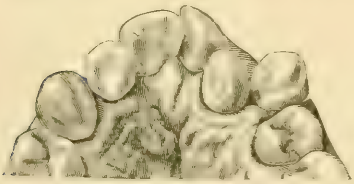


Fig. 165.

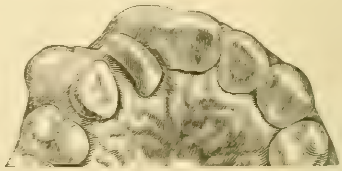


Fig. 166.

them. The mesial angle of the laterals infringes upon the inner surface of the distal angle of the centrals. These continue to rotate until the entire mesial surface of the laterals rests against the palatine surface of the centrals. Then the rotation naturally ceases, the laterals forming an abutment. Pressure being exerted on both centrals, in this way the angle is formed and the pressure on both sides being equal, they are not thrown out any farther. The direction of the cutting edges depends on the shape of the teeth.

If the diameters of the cutting edges much exceed those of the necks they necessarily overlap to a greater extent.

When the two centrals do not erupt harmoniously, one overlaps (Fig. 161). If, in addition to this condition, the force that is brought to bear on the anterior alveolar arch be very unequal, certain modifications occur. An unequal pressure exerted by the cuspids in their eruption will force one side of the arch farther

forward than the other. When the first molar on one side has been extracted, while that on the other remains, the forward movement is necessarily one-sided and a corresponding irregularity follows. The tardy extraction of temporary teeth goes far in forcing the germs of the permanent teeth out of place. Irregularity in the lower incisors, through faulty occlusion, modifies greatly the direction of the upper teeth.

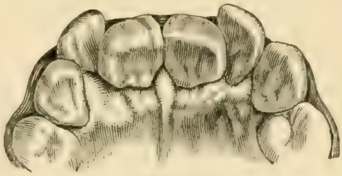


Fig. 167.

Sometimes centrals projecting in a line in front of the laterals are found (Fig. 162). In this case the centrals erupted properly. The arch being undeveloped, there was not room for the laterals. These were carried forward by the posterior column and in by the cuspids and possibly driven in by the lower incisors, which strike without, exaggerating the difficulty. When this is not the case and the laterals strike outside of the lower teeth, the upper arch is too large for the lower, and the upper centrals

Fig. 168.

not finding the proper support below, are forced out in a similar manner.

A similar condition is that in which the central incisors strike within the laterals (Fig. 163). The cause is the same; but the laterals, in erupting, fail to find the proper support and project outward, while the centrals occlude properly. In this case the upper maxillary arch is not necessarily too large for the lower, but the teeth are crowded.

One form of irregularity occasionally met with gives rise to

a right angle in the region of the cuspids, the incisors being in a straight line (Fig. 164). There are, of course, cases where the upper and lower arches resemble each other and where the occlusion is fair, which hence cannot be classed under irregularities. When this rectangular appearance is found in the upper jaw only, it is evidently due to a flexion in the region of the cuspids caused by the forward movement of the posterior column. The anterior alveolar column will be found thick, and therefore capable of resisting the pressure of the posterior column, and the pressure is spent on the weakest point, i. e., the region of the cuspid. Hence the flexion at this point. There is always excessive development of the upper jaw and alveolar process. This causes the teeth to erupt too far forward for occlusion with the lower arch and the lip draws them in until they strike the lower arch and the long axes of the teeth point inward instead

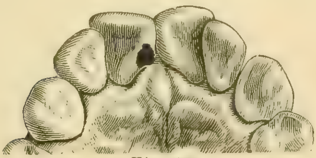


Fig. 169.

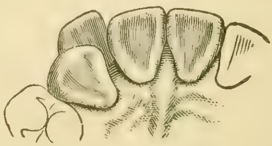


Fig. 170.

of outward. Thus the vault is brought forward, leaving the lower incisors without support.

The usual course of eruption of the teeth and harmonization of their development is occasionally disturbed. The germs that should be directly over the temporary incisors may be displaced. These should be situated above and anterior to the temporary teeth; but occasionally the germ is situated above and deflected posteriorly and thus it is liable to be erupted on the palatine surface. Displacement of the germs generally results in vicious eruption; for, however, slight as the tooth progresses, the line of its axes must diverge more and more from that of its normal position. The central incisors spring from a point farther back than it should be. If the elevation of the gum be followed, it will be seen that these two diverge more and more toward their cutting edges. Thus the relation of their axes is changed entirely and a partial rotation is produced (Fig. 165).

Again, if the roots of the temporary teeth persist, instead of

being absorbed as the permanent teeth advance, they materially interfere with the eruption of these and are apt to turn them out of their course. When one of the conical roots of the incisors infringes upon another not in the same line, as the teeth develop a tendency to rotation is established on the principle of the screw. This partial rotation upon its axis is more apparent the greater the diameter of the tooth, since the cutting edge, usually in line with the other teeth, now partakes of the revolution of the axis and so forms an angle with the arch.

In these cases when the tooth is fully erupted it finds a proper resting place on the opposing tooth. Its malposition may be corrected by the exercise of its proper function, but it often fails to find this and projects out, being without support.

Adventitious germs appear occasionally in the alveolar process. When these are found in the arch, they necessarily disar-


Fig. 171.


Fig. 172.

range the occlusion and throw the teeth out of their proper position. Supernumerary teeth usually appear at the median line, and then necessarily crowd all the teeth laterally. Frequently one supernumerary tooth is found exactly in the median line and centrals coming down to the right and left in the arch.

Occasionally two are found in the position where the centrals should be. In such cases the central incisors are generally located outside and anterior to the lateral incisors. When a supernumerary is found outside of the arch in the median line one central may be in position; the other may be thrown out or in and may be rotated 45 degrees upon its axis (Fig. 166).

The irregularities produced by the malposition of laterals are

1. Mesial surface of lateral overlapping distal surface of central, while distal surface is in a line with cuspid.

2. Mesial surface of lateral overlapping distal surface of central, while distal surface is behind the cuspid.

3. Mesial surface of lateral behind the distal surface of the central, while the distal surface is in a line with the cuspid.

4. Lateral in a line anterior to that of central and cuspid.

5. Lateral in a line posterior to central and cuspid.

6. Lateral at right angles with the line of the incisor and cuspid.

7. Lateral wholly inside the arch.

The lateral is found more frequently out of position than any other tooth because it is the weakest tooth in the arch and has the shortest root and is therefore more easily displaced.

The position of the central incisor is the combined result of the relative strength of the alveolar process, the force brought to bear upon it by the posterior column and the cuspid and the peculiarities of occlusion. The lateral, on the other hand, depends for its position on the combined force of central and

Fig. 173.

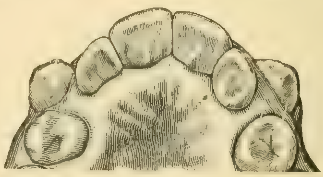


Fig. 174.

cuspid. Like other teeth, each lateral depends upon the environments of its own side of the arch, independent of the other. Besides its weakness, two other conditions are productive of its change of position: (1) the shortness and conical shape of its root; (2) its wedge-shaped crown. The shortness of its root, together with its conical outline, causes it to be more easily impinged upon by the root of the incisor, which will produce partial rotation. The wedge-shape of its crown facilitates rotation. The greater the diameter of the cutting-edge in proportion to that of the root the greater the degree of rotation must be before the lateral finds a resting place. If the diameter were equal to the space left and there were no impinging on the root, there would be no displacements. But when the space is not sufficient for the lateral and a pressure is brought to bear on one side of either cutting-edge or root, there must be a partial rotation which is proportioned to the diameter of the cutting-

edge. The wedge-shaped character of the crown assists in rotation, as the rounded angle of the anterior cusp offers less resistance than a line or surface. This gives rise to the commonest form of irregularity (Nos. 1 and 2, Figs. 167 and 168), in which the mesial surface of the lateral overlaps the distal surface of the central, while the distal surface of the lateral is either in a line with the cuspid or just back of it.

3. In those cases where the lateral is in a line with the cuspid (Fig. 169), but its mesial surface is behind the central, the cuspid having a much broader mesial surface, affords a firm abutment to the movement of the lateral, while the mesial surface of the latter easily glides over the narrow rounded distal surface of the central incisor. In this case the relative diameter of the upper and lower maxillæ determines the occlusion and position in a measure. If the lower maxilla and the upper be prop-

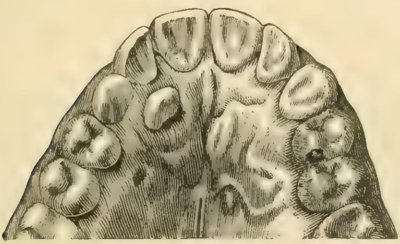


Fig. 175.

Fig. 176.

erly proportioned, the lower incisor may strike in front of the upper.

4 and 5. Laterals not finding room in the anterior column are met with in a line in front of that formed by the central and cuspid (Fig. 170), or behind it (Fig. 171). In both cases rotation is not produced by a one-sided pressure either upon the root or cutting edge. Whether the lateral is found without or within the line depends upon the relative diameter of the upper and lower maxillæ and occlusion. If the proper relation exist and the lower incisor strike within the upper, the upper laterals will be found outside the arch. When the diameter of the upper arch is greater than that of the lower, its laterals may be found within the line of the centrals and cuspids. In this case the lower incisors must either strike over the upper, which occurs

when there is a proper relation of diameters of upper and lower maxillæ or else behind the upper laterals. This can occur only when the upper arch has a greater diameter than the lower.

6. A rotation of 90 degrees so that the lateral is at right angles with a line passing through centrals and cuspids, can occur only when there is no obstruction to the movement of either root or cutting edge and where there is no proper occlusion (Fig. 172).

7. Occasionally a lateral is found wholly inside the arch. The cause is twofold. Sometimes the lateral is erupted so tardily that the cuspid pushes it out of its place. Then, even though erupted, the greater relative (Fig. 173) size and strength of the cuspid may in due time crowd it toward the palate.

The cuspid is the most important tooth in the anterior part

Fig. 177.

Fig. 178.

of the mouth in regard to durability and influence on expression. It owes its durability to the hardness of its tissue, slowness of its development and simplicity of shape. The absence of sulci lays it less open to the inroads of caries. The pyramidal shape of its cusp gives it great power of resistance. Its strength depends on these conditions and the length of its root, which exceeds that of any other tooth. Owing to the length of its root its cusp may move farther from its normal axis without really forming a greater angle with it. It is placed at the angle between the anterior and posterior columns, forming the key-stone; hence it is of the greatest importance in expression. The shape of the crown may vary from the agreeably rounded outline of beauty to the prominence of the tusk of a wild beast. The limits of variation of form and position thus being greater than

those of any other tooth, it attracts attention and helps to make or mar beauty. Deviations from its normal position may be due to malposition of the germ or crowding out of place.

When no source of pressure upon the erupting tooth can be recognized, such as is the case when the cuspid erupts in the vault, it is safe to assume the former.

Fig. 179.

In both deciduous and permanent sets as compared with other teeth, the cuspids are late in erupting. In both it must seek its way between two teeth already erupted, hence its liability to be forced out of place.

The permanent cuspid rarely erupts before the twelfth year after the centrals, laterals and bicuspids are in position. It is crowded and therefore meets with obstacles in its descent. Its

Fig. 180.

crypt is placed above and in front of those of the lateral and bicuspid. As at the age of nine the roots of the incisors and bicuspids are pretty well calcified, the cuspid may be materially hindered in its eruption by these when there is a lack of space. Its conical root makes it yield easily to pressure and its cusp glides readily over the roots of the adjoining teeth. If its calcification and the decalcification of the temporary teeth do not occur

simultaneously a new factor of disturbance arises, for, by the pressure of an additional obstacle in the shape of a remaining portion of the root of a deciduous tooth, the cuspid may be thrown out of its course, while a too rapid absorption of a deciduous root leaves the column of resistance broken, thus opening a new channel for the erupting tooth.

The position of its crypt above and in front of those of the lateral and bicuspid accounts for the most common form of irregularity, i. e., being outside of the arch and above the other teeth. The tendency of the cusp is necessarily forward, because the combined force of the bicuspids and the first permanent molar from behind is greater than that of the lateral in front;

Fig. 181.

hence the lateral is easily pushed out of place. Besides, the roots of all teeth pointing backward naturally give it this tendency.

When in its normal position the cuspid pushes its way between the roots of the lateral and bicuspid, thereby spreads the arch, giving it a parabolic outline and forming a key-stone. When it remains outside of the arch, the expanded contour is lost and a pinched condition results in the shape of a V-shaped arch. The additional pressure of the cuspid upon the region of the lateral only increases this tendency. The cuspid, when out of place, is usually found above and outside of the lateral and bicuspid, this tendency being given by the position of its germ and its calcification being late as compared with other teeth. (Fig. 174.)

One or two cuspids may be found erupted in the palatal vault when there is a malposition of the germs (Fig. 175). Occasionally the cuspid is found outside of the first bicuspid or between the first and second bicuspid, sometimes in front or anterior to the lateral (Figs. 176 and 177). Frequently it takes the place of the lateral (Fig. 178). Sometimes one cuspid is found in the palate, while the other is on a line pointing inward (Fig. 179). When it comes through in this position the deciduous cuspid may still be in position, the first bicuspid having crowded forward to the lateral (Fig. 180). Occasionally when the cuspid is missing, the lateral will drop backward (Fig. 181). Its usual position when in the palate is inside the lateral incisor, but sometimes it is embedded in the hard palate. A pinched condition in the bicuspid region necessarily results from such malposition, due in part to want of prominence of this tooth when in normal position and in part to the inward pressure of the cuspid upon the bone-cells (Figs. 182 and 183). When the

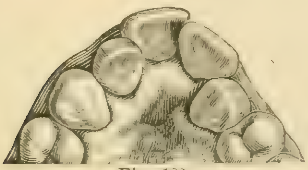


Fig. 182.

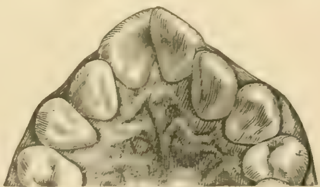


Fig. 183.

cuspid moves out of position it does so at the expense of the first bicuspid and lateral incisor. The force may be so great as to push the lateral forward and through the alveolar process. When the cuspid is found in the roof of the mouth, or out of its normal position, the posterior column moves forward, filling the space usually occupied by the cuspid (Fig. 178) and the half of the arch of which this tooth is a member remains undeveloped (Fig. 182). If the cuspid erupt simultaneously the pressure exerted is uniform and there is less liability to irregularity. One may erupt normally, while the other may be abnormal in position.

The shape of the crown of the bicuspid renders it particularly liable to irregularities of position. The antero-posterior diameter of its outer cusp is greater in proportion than that of the inner,

having a wedge-shaped space on the palatal side. This causes it to touch at one point the tooth in front and back of it and makes rotation upon its axis easy. Irregularities are chiefly limited to the second bicuspid for reasons that become apparent when their causes are considered.

Like irregularities of other teeth, irregularities of bicuspids may arise from constitutional causes, i. e., (from a lack of accord between the size of the jaw and that of the teeth) or from local causes. The latter are frequent. They are (1) tardy eruption; (2) deflection due to the retention of temporary roots; (3) forward movement of the molars, and (4) rotation from want of occlusion.

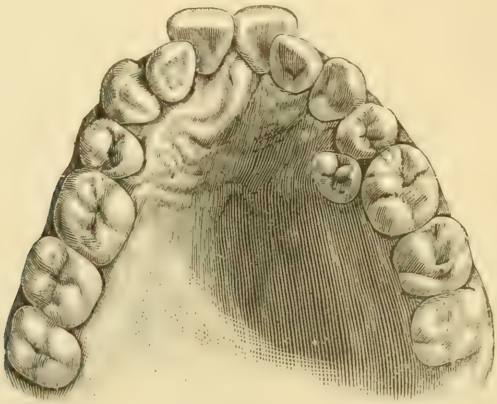


Fig. 184.

1. Tardy eruption. The natural order of eruption is: first bicuspid, second bicuspid, cuspid. But this is sometimes disturbed, so that the first bicuspid is followed by the cuspid, thus pushing it backward. When there is a lack of space the second bicuspid must seek its way between the first bicuspid and the first permanent molar and if there is a lack of room it is crowded outside or within the arch (Fig. 184).

2. Deflection. When a temporary molar is retained too long or its root is not absorbed as fast as the bicuspid is erupted, this obstacle may deflect the bicuspid or cause it to rotate more or less upon its axis, being favored by the spongy character of the alveolar process (Fig. 185).

3. The forward movement of the molars necessarily diminishes the space left for the bicuspids and cuspids and when the first bicuspid and cuspid erupt before the second bicuspid, this may be crowded out of its proper place.

4. A rotation of a bicuspid from a want of proper occlusion is not rare. An examination of the grinding surface of the bicuspid shows that it is designed to articulate with an opposing tooth. When its two cusps fail to find an opposing cusp to keep them in place its function is lost and its fixedness of position endangered.

Frequently more than one of these causes are at work or one implies another. Thus, if there is accord between the size of the jaw and that of the teeth, some of the local causes cannot

Fig. 185.

arise; the cuspid may erupt before the second bicuspid without disarranging the arch and a bicuspid may be deflected by a deciduous root and ultimately move into place unless crowded upon by a six-year molar. Rotation may be the result of a crowded condition, throwing the tooth out of the arch when proper occlusion is out of the question.

As the first bicuspid erupts before the second it has the advantage of such space as there is. It may be crowded out of place by the forward movement of the six-year molar together with the premature eruption of the cuspid. Permanent deflection due to the retention of a deciduous root is out of the question when there is sufficient space, but rotation upon its axis from want of proper occlusion may occur here as elsewhere.

The posterior surface of the bicuspid touches the first cuspid only at one point, being an angle and not a surface, and this is a fruitful source of irregularity.

Irregularities first attracted attention by the deformity they produced, not by their interference with function. Overcrowded anterior portions of the arch and displacement of individual teeth were noticed. It was long ere the results of injudicious extraction were observed. The first permanent molar was ruthlessly destroyed until comparatively recent times, producing a large proportion of irregularities in the form of malocclusion. This loss of function was produced so gradually that the patient was not aware of it. He might notice inconvenience in mastication, but did not attribute it to the cause, since even persons of great intelligence know but little about occlusion of their teeth.

This tooth has hitherto been sacrificed for two reasons: (1) Its early decay, brought about by the tax upon the system of the growing child and the neglect from which the teeth suffer, particularly during the period of its development. The parent usually did not know of its existence until the child complained of toothache. (2) It has been extracted to correct an overcrowded arch.

When removed to stop pain, the pain is indeed relieved by extraction, but leaves in its train many evils. When removed to correct a crowded arch, twice as much space is gained as desirable. The crowded arch is not relieved, as the cuspid, because of the length and strength of its root, remains stationary, while the bicuspids move back singly or in pairs, leaving the position of the incisors unchanged. The disastrous effects of extracting the first molar become apparent when its function is understood.

As Dr. J. E. Cravens,[1] of Indianapolis, has remarked, "The first permanent molar has four distinct functions: (1) To supply additional surface for mastication when development has progressed so that the deciduous molars, unaided, are no longer competent to meet the requirements of nature. (2) To support the crowns of the deciduous molars when they have become

[1] Annual Universal Medical Science, 1888.

unstable, because of absorption of their roots to accommodate the advance of their immediate successors—the bicuspids—which are usually erupted between the ninth and the eleventh years. The deciduous molars begin to loosen six to twelve months before their final displacement. Should a permanent first molar be extracted early—say between the seventh and eighth years—the deciduous molars supported by it would loosen prematurely so as to be unserviceable for mastication and perhaps be lost six to twelve months before the eruption of the succeeding bicuspids. (3) To guide the second bicuspid into position in event of a loss of this molar previous to eruption of the second bicuspid, the latter is liable to erupt back of its true position, or after erupting normally to float backward along the ridge of the gum, inclining posteriorly in such a manner as

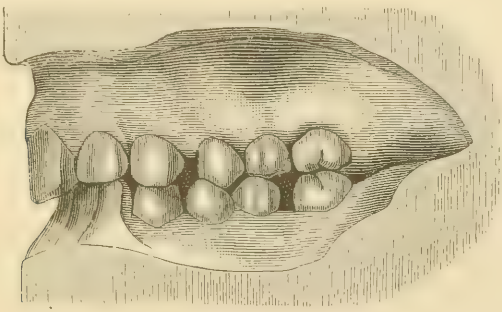


Fig. 186.

seriously to impair its effectiveness as a masticating organ. This is particularly the case in the inferior maxilla. (4) To induce additional development of the horizontal portion of the lower jaw, immediately anterior to the ramus, in order to make easier the eruption of the permanent second molar and to prevent the well-known tendency of the latter to tip forward, thus weakening the support of its roots and impairing its value as a grinder.

The first permanent molar is supposed by many observers to exercise an important influence in establishing a proper angle to the inferior maxilla. If such idea is correct (and several conditions indicate that it is) it adds possibly another to the already long and important list of the functions pertaining to this tooth."

The wholesale extraction of the first permanent molar in the past, no doubt arrested development of the alveolar process as well as of the maxillary bones, since development of the process and jaws depends largely on the function of the teeth, their articulation and their motion stimulating nutrition and enlarging the arch.

Some dentists with a skill the result of routine rather than knowledge, are still extracting four sound molars without the least thought of the consequences. Such a one, who was practicing in a southern parish not many years ago, was in the habit of taking out the first permanent molar in every instance. The result was, he claimed, "that all the people in that part of the country possessed good, regular teeth and that an irregularity was the exception." I have after observed the want of development of the alveolar process and sometimes the jaws from the extraction of those teeth. This also occurs in cases where the germ has not developed and the tooth is missing. More marked instances are those where three or four germs are wanting. The loss of a tooth performing such a work as the first permanent molar impairs mastication and produces vicious occlusion and is detrimental to the contour of the face.

When extracted before the second molars erupt, one-half or more of the grinding surface of the teeth is lost. The nutrition of the patient suffers in proportion and health may be seriously impaired because of inability to masticate food properly. The horizontal portion of the lower jaw is but imperfectly developed because function, one of the most important means of development, is lost and insufficient room is left for the second and third molars.

When the jaw with deciduous teeth is compared with one having permanent teeth, there is noticeable a difference in the length of the rami and bodies, and a still greater difference in the angles. This difference results from the gradual separation near the angle and is due to the growth of the molars. The arches of the permanent set are separated posteriorly by the eruption of the first permanent molar. When these molars are lost before the second molars are in place, the characteristic angle of the jaw becomes less marked. The loss of this molar on

one side only will produce asymmetry of the two sides of the face, noticeable to the trained eye the parallelism of the two arches having been disturbed. If the two be lost early the jaws approach each other more than normally near the angle, throwing the force of mastication forward. As the first and second bicuspids do not erupt until the tenth or eleventh year, and the deciduous molars loosen six to twelve months before they are displaced, the child is forced to masticate its food for several years on a portion of the arch designed for other purposes, compelling these teeth to perform the unnatural function of grinding. This confusion of functions has imperfect results and changes the facial outline of the face.

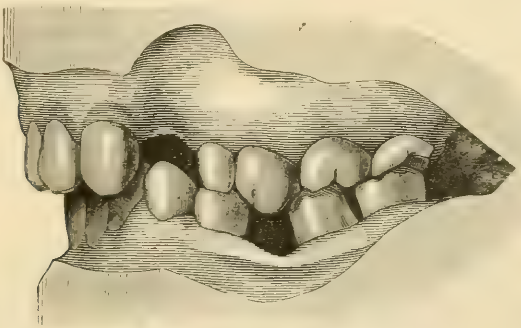


Fig. 187.

As the first permanent molar erupts it acts as a fixed point separating and holding the jaws somewhat throughout their entire extent in front, as well so as to make room for the growing incisors. The deciduous incisors being very much shorter than the permanent ones, necessarily have a shorter bite. When the first permanent molar is lost the natural bite is shortened, for this molar acts as a force which lengthens the arches backward and also separates them vertically.

When this tooth is lost the lower permanent incisors as they develop strike with greater force against the upper and are carried forward. The change at first is imperceptible, but in the course of time these teeth will be found spreading more or less like a fan. Though the organic relation of the upper and lower jaw is not apparent at first as that of other organs and the two

jaws seem to enjoy greater independence, proper occlusion is indispensable to their health and the teeth in the lower arch are forced out of their sockets by a deposit of osseous material not consumed through proper function.

Naturally bicuspids tend to move forward because of the inclination of the root and the angle formed by the two jaws, which makes the teeth strike at an angle as well. This tendency usually prevents them from moving back, even if the first molar is extracted. When the cusps are long they usually retain their natural articulation, but sometimes, as has been pointed out, they move backward. They may move back separately or may drop back together (Fig. 186). This dropping back destroys the articulation, causing the opposing teeth to strike only at

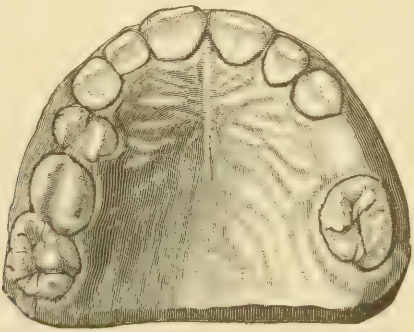


Fig. 188.

certain points, instead of bringing surfaces in contact and frequently partial rotation upon their axes results.

The most ordinary result of the extraction of this tooth, as Dr. Davenport[2] has shown, is the forward movement of the second and third molars (Fig. 187), causing these to tip forward and resulting in vicious articulation. Externally the articulation may appear not to have suffered, but when it is examined inside of the arch, it is found that the opposing teeth meet only at certain points, becoming thereby partially useless. Fig. 188 shows the forward movement of the first permanent molar. The temporary molars on the right side are in place, thus holding

[2] Dental Cosmos, July, 1887.

the first permanent molar in place; while on the left side the temporary molars have been extracted and the first molar has moved forward one-fourth of an inch. The force of mastication and the direction of the roots, together with the eruption of the second molar, increases this tendency.

Length of the rami body, depth of sulci of masticating surface and local irregularities of the teeth in front, may so modify the occlusion as to result in bilateral asymmetry and the degree of tipping forward may be quite unlike.

CHAPTER XXVII.

LOCAL CAUSES OF TEETH IRREGULARITIES—LOWER JAW.

The upper and lower jaw are, as already pointed out, distinct in character, function and course of development.

The upper jaw, when normal, describes a portion of a larger circle, the teeth overlapping those of the lower. It is fixed and depends for its function on the activity of the lower. Owing to this immobility, irregularities are more markedly constitutional in type. Thus, the various abnormal arches not seen in the lower, the high and narrow vault and the inward curvature

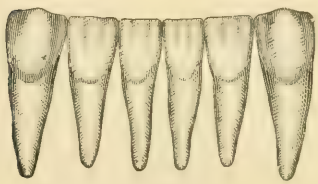


Fig. 189.

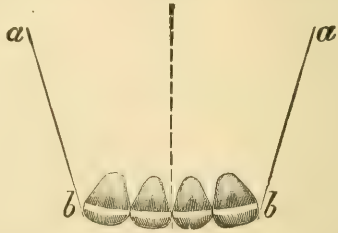


Fig. 190.

of the alveolar processes occur. The upper jaw has a greater sweep of development and consequently greater possibility of irregularity in its anterior columns as these are unrestricted. The lower is restrained by the overlapping of the upper teeth. The lower jaw is hung loosely, but firmly by its condyles, permitting motion in three directions—antero-posterior, vertical and lateral.

In Fig. 189, the six anterior inferior incisors are shown. The points of contact are at their cutting edges, the mesial and distal surfaces being rounded which enables them to crowd easily past each other when force is applied. The roots are flattened at their sides, so that when pressure is brought to bear upon them they move with readiness over a considerable distance. That pressure cannot well be exerted in a straight line through the posterior column and from thence extend in a curve through the

anterior teeth, from the law of simple forces, which act in straight lines only. The cuspid, finding no resistance in front, but being resisted by the incisors slightly at the side, necessarily pass forward. The lateral is too weak to afford resistance. Even if the centrals could be acted upon by the pressure from behind, they would not be prevented from assuming a V-shape by the overlapping incisors above, since the more the upper arch is compressed laterally and the mesial angle of the central is turned outward, the more will the distal angle be turned inward, and thus confine the lower incisors.

The narrowness of the lower incisors as compared with the upper favors this tendency. These conditions are necessarily modified by the local peculiarities of the upper arch, relative

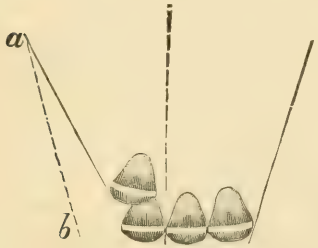


Fig. 191.

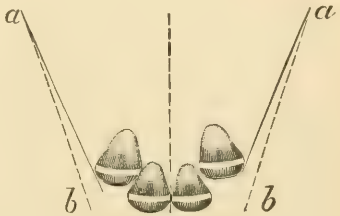


Fig. 192.

strength of teeth and nature of occlusion being all important factors in determining final results.

In Fig. 190 is a normal lower maxilla. The line a b, passing through the cuspids, bicuspids and molars, shows the direction of the force exerted by the posterior column upon the anterior. For growth the lower jaw depends far more upon function than the upper. The growth of the lower jaw is limited to the posterior column. This is accomplished by absorption of the antero-posterior border. The freedom of motion is retarded by the arch of the upper, for which reason irregularities are much rarer in the lower than the upper jaw, since overlapping of the upper teeth tends to correct predisposition to mal arrangement.

Irregularities of the lower jaw result more from local causes than those of the upper except such as are found in the underhung jaw. Its development depends largely on mastication.

Owing to its movements there are fewer irregularities in this maxilla and the jaw is more apt to be normal. Irregularities back of the cuspids are very rare. Occasional contractions of the lower arch occur, dipping in, is due to peculiarities of occlusion. When cases of irregularity exist, they are generally found in mouths, the lower arch of which exceeds the upper in diameter, thus permitting less firm interlocking and greater freedom of individual teeth.

When the diameter of the circle of the teeth of the lower jaw exceeds that of the upper, its lateral movement causes an enlargement of the upper circle by opening the median suture, this condition being indicated by the spreading of the superior central incisors. As has been shown in the chapter on migration of teeth, twisted bicuspids often result from entire want of occlu-

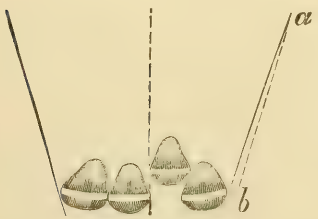


Fig. 193.

Fig. 194.

sion, or the touching of two opposing teeth at only one point. The most frequent form of irregularity is a crowding of the incisors. This is generally the case where the size of the teeth and the jaw are not in harmony. It is due to two causes: (1) The teeth of the lower jaw are forced inward by occlusion, the diameter of the circle of the upper teeth being usually the smaller; (2) The forward movement of the posterior column.

The two halves of the lower arch, like those of the upper for obvious reasons do not present the same forms of irregularity. Like the upper jaw, the lower is subject to forward movement of the posterior column. A want of harmony in the development of upper and lower maxillæ produces a crowded condition of the lower arch, resulting in pressure upon the anterior column.

The direction of the roots of the lower molars greatly increases this tendency. When the crowns of the second and third molars are erupted, the first molar is pushed forward. The pressure is exerted principally through the posterior column upon the cuspid and is in a straight line. This tooth, by virtue of its rounded cusp, slips by the lateral and is projected forward often beyond the central incisors, leaving the lateral behind.

Like the upper maxillæ the two halves of the alveolar arch are separate and are modified independently. An irregularity on one side by no means indicates a similar irregularity on the other, owing to the difference of pressure that may be exerted.

In Fig. 191 the left dental arch is seen to be normal, but the

Fig. 195.

forward movement of the posterior column has caused the right lateral to fall behind. As the two columns converge anteriorly they exert their pressure in this direction, in consequence irregularities of the lower jaw are confined for the most part to the region of the incisors.

Though the laterals are generally pressed within, while the centrals occupy their usual position, these teeth may stand at various angles determined by local peculiarities of the teeth of the upper maxilla. Thus it may happen that a cuspid or a lateral may strike outside of its antagonist of the opposite jaw.

In Fig. 192 a common form of irregularity, in which both posterior columns have moved forward. The laterals are crowded backward and inward. The lines of force are also directed inward, but a V-shaped arch is prevented by the lower

centrals striking against the palatal surfaces of the upper centrals. If the cause of this form of irregularity be borne in mind it will be understood why extraction of a lower lateral or central renders this irregularity worse, inasmuch as it disarranges ccclusion of the cuspids.

In Fig. 193 the right dental arch is normal. The left posterior column has pushed against the lateral and, meeting with sufficient resistance, the central is carried backward. While erupting, the central was carried inward, owing to a want of harmony of development. Two centrals have been found directed inward, though this form of irregularity is rare.

In Fig. 194 the left dental arch is normal. The forward movement of the posterior column on the right side has caused the cuspid to advance beyond the line of the incisors. The rotation of the cuspid upon its axis caused it to pass by the

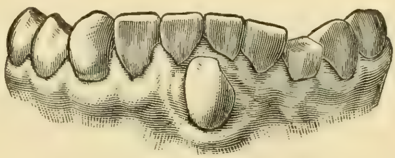


Fig. 196.

lateral, leaving it in position. This is a common form of irregularity. Occasionally the cuspid is carried forward in the direction of the pressure. Such a case is illustrated in Fig. 195. The left lateral has been carried inward in the manner already described. The posterior column has pushed the cuspid on the right side laterally so that it occupies the position of the right lateral and the bicuspid is carried forward and outside of the arch.

The cuspid erupts in line with the other anterior teeth unlike the upper, the crypt of which is above and outside of the lateral incisor and bicuspids. For this reason and the fact that the upper cuspid tends to keep it in position by occlusion, irregularities of the cuspid of the lower jaw are not so common as those of the upper. When the tooth is found out of line, it is anterior to its normal position—rarely, if ever, posterior. Its eruption may be tardy, giving the advantage ot time to the upper cuspid and directing the lower cuspid outward. In a crowded jaw, disarrangement of the incisors may follow, leaving the

lateral almost directly behind the cuspid, as in Fig. 195. When there is malposition of the cuspid on one side of the maxilla, the cuspid of the opposite is usually pushed forward, as seen in the same illustration.

Owing to malposition of the germ, the cuspid may be found outside of the incisors in the median line (Fig. 196), or even inside of the arch (Fig. 197). Rarely it is found on the median line between the incisors, as shown in this illustration.

Like the cuspid, the position of the bicuspid is most frequently affected by the forward movement of the posterior columns. Irregularity in a lateral direction is rare, since density of the lower maxilla is unfavorable.

If a bicuspid be found without or within the arch, its position is due to undue retention of the temporary teeth. In Fig. 198

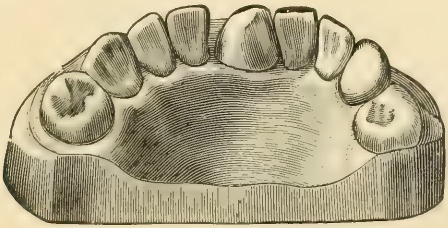


Fig. 197.

the second bicuspid is situated inside the arch, while in Fig. 199 the first bicuspid is inside and the second bicuspid outside of the arch. Twisted bicuspids occur frequently from want of proper occlusion, when the space yielded by the lower jaw is larger than that of the upper, or when the first molar is extracted.

When the second temporary molar is retained too long, the first permanent molar may be pushed forward, thus confining the bicuspid and preventing it from erupting.

That teeth move when acted upon by external force is well-known, and the fact is utilized in operations for producing temporary separations in regulating and the like. Why they should move from their normal positions without any apparent cause is not very easy to explain. When the arch of the alveolar process is greater than that of the combined diameters of the teeth, there must be space or spaces somewhere. This space is usually equally distributed among the anterior teeth. Sometimes, how-

ever, spaces are found that disfigure the mouth and besides one or more teeth appear to have rotated upon their axes.

These motions are best considered under two heads: (A) Perfect occlusion; (B) proper relation between waste and repair.

(A) If the occlusion of the teeth be perfect, so that each tooth is kept in place by its adjoining neighbors and the opposing tooth, dislodgment is impossible. Each tooth should touch that adjoining them at the extremities of their greatest diameters. This allows a slight lateral motion.

Good occlusion differs according to the function of different teeth. The upper and lower incisors overlap each other, producing what is termed the overbite. In the normal relation they strike in a straight line, which passes through their roots.

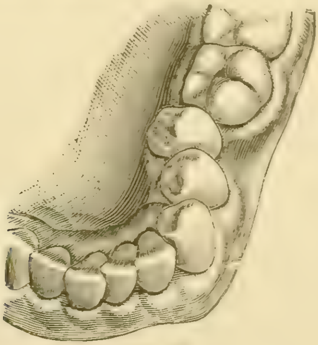


Fig. 198.

The curved lingual surface of the upper incisors allows for their sliding into this position. The force being thus exerted in straight lines there is constant tendency to keep them in position and as the pressure is upward and downward vertical spreading of the upper incisors is impossible. The relation of cuspids is similar. Quite otherwise with bicuspids and molars. Beginning with the bicuspids the cusps of the first superior bicuspid are found striking not over that of the first lower bicuspid alone, but over the angles formed by the distal side of the first lower and mesial side of the second. Each tooth beginning at this point is not only in relation to one below, but to two. When one of these teeth is extracted the order of the mouth is disturbed and rearrangement of some kind usually follows. What this will be depends on a variety of circumstances.

A typical example is furnished by the extraction of the first molar. The forward movement of the second molar follows as a consequence. A tilting forward of this tooth results. The reason for this is obvious. The posterior cusp of the first upper molar strikes the anterior cusp of the second lower and exerts its whole force, which was meant to be distributed on both cusps.

(B) The position of the teeth alone does not determine the relative size of the maxillæ and the occlusion of the teeth. Nutrition and absorption, waste and repair play an important part. On perfect harmony of these, beauty and health of the teeth depend. Changes in the position and removal of bone-cells constantly vary with age and other physical conditions of the patient.

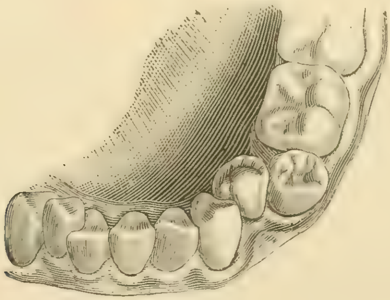


Fig. 199.

This disposition and removal of bone-cells is seen in the changes that the lower maxillæ undergo during the different periods of life. When the deciduous teeth are replaced by the permanent ones, the arch of the jaw becomes more pronounced and there is a lengthening of the alveolar ridge backward to accommodate the molars. When the senile changes take place the angle of the jaw becomes more obtuse. That there is a similar adjustment to circumstances going on constantly is proven by circumstances. Correction of irregularities depends on this. The position of the teeth in the alveoli is determined solely by the tissues around it. By producing a pressure in a given direction bone-cells may be removed on one side and others deposited on the other, and the position of the tooth changed. The change in the deposit

and removal of osseous matter is not unlike that of the deposit of particles of earth in the bed of a river, where stakes have been placed for the purpose of locating the bed of the river. By successive deposit and removal of these particles the position of these may be changed and even the current of the river. Similar changes in the contour and density of the alveolar processes occur, depending on the changes of blood supply and absorption. Irritation may thus stimulate the activity of the capillaries to a more than ordinary degree of repair.

Every tooth exerts a pressure of its own in different directions. Were this not so it would be difficult to account for the elongation of a tooth when its opponent is extracted. This pressure is healthy and implies the antagonism of opposing teeth. If this occlusion is wanting, the relation of waste and repair is disturbed. Excess of bone-cells is often deposited as a result.

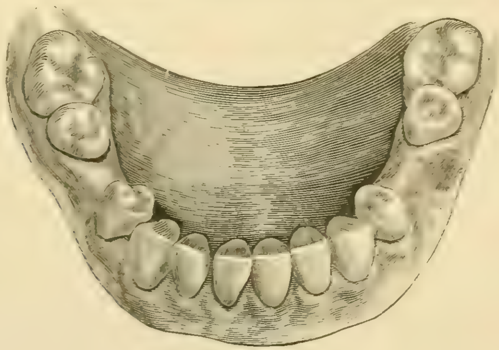


Fig. 200.

When these two fundamental laws of good occlusion and balanced waste and repair are violated, one of the three following conditions follows: 1. Movement of individual teeth in straight lines. 2. Rotation of individual teeth upon their axes. 3. Forward movement of groups of teeth and the alveolar processes supporting them.

When alveolar processes and teeth correspond in size and the occlusion is good, as already stated, spaces between the teeth are out of the question. Sometimes a space is found between the central incisors. If the occlusion be good otherwise, this space is due to continuance of growth at the margin of the

suture. There is a greater deposit of osseous material than is needed, producing a larger diameter of the jaw than the teeth. This begins, usually, at an early period in life and continues till the growth of the osseous system has ceased. As the jaw develops in the child while the temporary teeth remain, it is but natural that spaces should be formed in time until the permanent teeth take their place.

Spaces may be artificially created gradually by forcible separation by wedges. In former years, when more force was applied by dentists, irritation was created and absorption on one side induced. In this way several teeth were sometimes crowded in one direction. When the anterior incisors do not strike on a line, but at an angle so that the cutting-edges of the lower incisors strike against the inclined plane of the lingual surface of

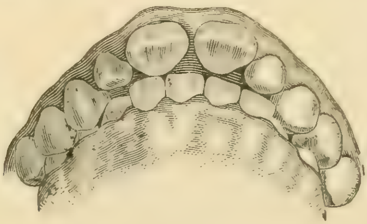


Fig. 201.

the upper incisors, outward pressure is exerted and the incisors separate. The spaces so frequently seen in the permanent incisors in children are produced by tardy eruption of the cuspids. When the cuspids come down into place these spaces disappear. Spaces are rarely, if ever, observed between molars.

Again, the lower jaw, if too large for the upper jaw, may act as a wedge and by striking against it may spread the central suture. The spaces between these teeth are usually found to be healthy. It is not reasonable to suppose that either salivary or germinal calculus or inflamed gums could produce this motion. Were the pressure exerted on one side only there might appear to be some ground for this supposition, providing the calculus exerted a pressure too great for the rest of the teeth to resist. But when calculus is deposited on both sides the pressure exerted would be counter-balanced and lateral motion could not take place. Those who hold this opinion are

probably misled by the fact that a tooth may be dislodged by calculus from its socket vertically. In this case the calculus diminishes the diameter of the socket and the wedge-shaped root is forced out.

When a tooth touches its opposites only at one point, or the opposing tooth was extracted as it frequently happens with bicuspids, instead of articulating with surfaces, rotation may result. In this case bone-cells are deposited on one side, while those at an angle with these are removed. This produces a slight rotation which twists the tooth. That this process is physiologic is proven by the healthy state of the gums and alveolus, which is found in most of these cases. In Fig. 200 is seen not only the rotary motion to the bicuspids, but also spontaneous motion in direct lines—a condition frequently observed.

In young persons when the blood supply is rich with nutri-

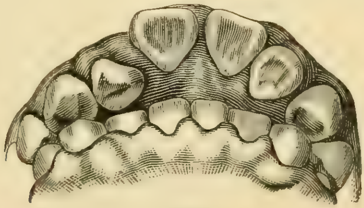


Fig. 202.

tious material and when waste and repair go on rapidly, four and sometimes six anterior teeth and alveolar processes are carried forward. This proper occlusion with the inferior incisors becomes impossible. These become elongated, and, failing to find support in the upper incisors, strike against the roof of the mouth. Irritation is produced and an excessive flow of blood to the parts follows.

One of the most interesting forms of irregularity thus resulting, is that in which the inferior incisors impinge upon the mucous membrane of the mouth and the superior centrals, laterals, cuspids and bicuspids, having moved forward, project to such an extent that the upper lip cannot close over them.

These cases, while found in normal individuals, occur also among idiots, deaf-mutes, the blind and insane. The deformity, not seen in temporary teeth, is confined to the permanent set, beginning at the seventh or eighth year and increasing with age.

When not corrected the teeth will finally project at an obtuse angle. In a woman fifty-five or sixty years of age the teeth will project almost horizontally. The vault connected with this irregularity, usually low, is sometimes high. In this case it is more pronounced; just as V and saddle-shaped arches are more pronounced when associated with a high vault. Irregularity begins at the central incisors, extending backward. Generally later in life tartar collects around the roots and interstitial gingivitis sets in, exaggerating the condition.

In the majority of cases the superior maxilla is arrested. The teeth project at an angle of 20 degrees, carrying the alveolar process with them so that they strike over the lower incisors.

Dr. Kingsley (who first described this form of irregularity) correctly claimed that this condition is neither inherited nor the

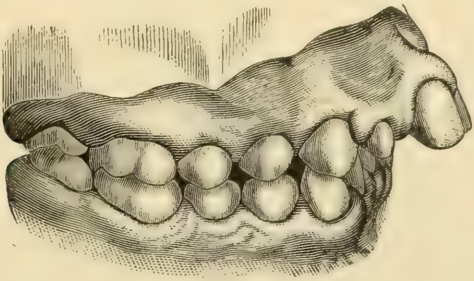


Fig. 203.

result of thumb-sucking. The conditions under which this irregularity is brought about are both constitutional and local. Excessive proliferation of bone-cells does not begin before the sixth or seventh year, hence, not until the permanent teeth are erupted. A want of balance of nervous function, resulting from neurotic conditions or a transmitted tendency to disease, may interfere with the centers of ossification. This interference, as has been shown, frequently finds expression in the anterior part of the mouth, sometimes producing a high vault, contracted arches, excessive or deficient deposition of bone-cells. The conditions are mostly confined to neurotics and degenerates. Excessive proliferation of bone-cells near the median line of the superior alveolar process tilts the axes of the erupting centrals slightly outward. This direction once being given to them, when the

lower incisors strike against them they do not find resistance of correct occlusion, but act as upon an inclined plane, throwing them out more and more during the process of eruption. This must necessarily terminate in striking the process itself; the increased activity of nutrition which irritation sets up results in excessive development, which in itself is an evidence of degeneracy. The tilting forward of the upper incisors increases the distance between them, and the lower incisors do not find the resistance belonging to natural function. The consequence is the elongation of the lower anterior alveolar arch. Eruption of the first permanent molars determines the relation of the jaws to each other. Occasionally, however, they do not develop their

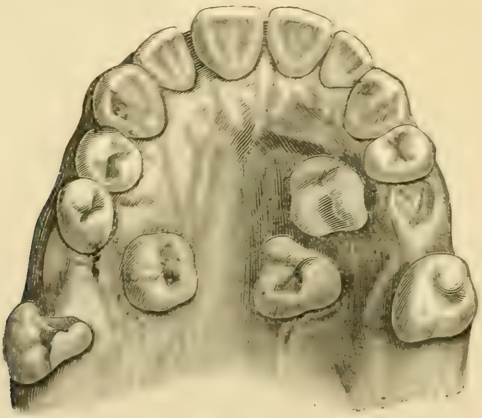


Fig. 204.

full length. In either case the lower incisors strike against the mucous membrane of the roof of the mouth, which constant irritation stimulates deposition of the bone-cells in the process. Were occlusion correct, constant pressure on the roots of the teeth would, in part, conterbalance excessive deposit by waste. As it is, the roots of the upper incisors form an angle with the cutting-edge of the lower teeth and as the mouth opens and closes, the force of the lower incisors is not only spent on the superior process, but also through it on the roots of the upper teeth, forcing them out more and more. In Fig. 201 is seen the starting-point. The central incisors have just commenced to move forward, in the mouth of a girl eleven years of age.

The trouble is extended to the neighboring teeth from the nature of the occlusion. In Fig. 202 the incisors and alveolar process are seen carried forward by excessive deposition of bone-cells. By action of the lower lip, which cannot close over the cutting-edges of the upper teeth, but soon gets between the superior and inferior incisors, the former are pressed out still more. Fig. 203 shows a side view of this irregularity. In Fig. 204 is seen a remarkable migration of the molars.

Want of function encourages deposit of lime salts around the roots of the teeth, inducing interstitial gingivitis later in life and loosening the teeth.

A common dental irregularity resultant on extraction is elongation of the teeth on the opposite jaw (Fig. 203). To remain in position and to retain a healthy alveolar process, teeth must have resistance power. If two teeth be extracted upon one jaw, in tooth or teeth on the opposite there is no occlusion when the jaws are closed. In a sense these teeth become foreign bodies. In reality they come under the suppressive economy of growth (loss of the function of mastication). Owing to transitory nature of the alveolar process, interstitial gingivitis sets in and about the roots of the teeth.

Deposition and absorption of bone results from both normal processes (as in development of the skeleton) and from irritations (the deposition and absorption of bone about a fracture). Inflammation in the alveolar process about the root or roots of the teeth under favorable conditions likewise build up or absorb the alveolar process. Bone building produces lengthening of the teeth. Interstitial gingivitis frequently becomes permanent. Pyorrhœa ensues with deposits upon the roots as a result of bone absorption.

CHAPTER XXVIII.

LOCAL CAUSES OF TEETH IRREGULARITIES—FINGER-SUCKING.

Elsewhere reasons have been given why the high vault and the V and saddle-shaped arches cannot be ascribed indiscriminately to thumb-sucking, as has been the custom.

The greatest confusion of ideas has been current among practitioners as to the etiologic differentiation of these cases. The conditions due to thumb-sucking should be so described that the student is aided in making a diagnosis. In cases of irregularities, due to thumb-sucking, several teeth and the alveolar process are often brought forward. Frequently spaces are found between them so that they stand out more and more fan-shaped. The vault, while it may be high, is usually low. The

Fig. 205.

teeth are frequently affected only on one side, the shape and extent depending upon the direction of the force and the hand employed in sucking. In the V-shaped arch the teeth are crowded and point toward the center, owing to a force applied by the posterior column and spent on both halves toward the median line. The vault may or may not be arched. In the saddle-shaped arch the teeth are crowded, except in cases due to hypertrophy, and they stand perpendicular. The vault may be high or low. In cases of thumb-sucking, the teeth of the inferior maxilla do not articulate properly with the upper and are often turned inward, which is caused by the pressure of the thumb upon the cutting-edges. The distinguishing feature of a case of thumb-sucking, therefore, is the spreading of all or a part of the anterior teeth and the lower teeth usually turned inwards.

When the vault is high it may be quite marked in the anterior portion of the roof of the mouth. This is by no means a characteristic feature. As the habit of thumb-sucking usually terminates before eruption of the permanent teeth, cases of irregularities resulting in children over ten years of age are rare.

Infants usually commence to suck their fingers within a few hours after birth—in the majority of cases not later than the first week. The habit is therefore well fixed before the temporary teeth begin to erupt. This being the case, the teeth and the alveolar process are naturally affected in their development if the pressure is continuous. The extent, shape and location of the irregularity depends upon the hand employed and the position of the thumb and finger used. The right or left side are

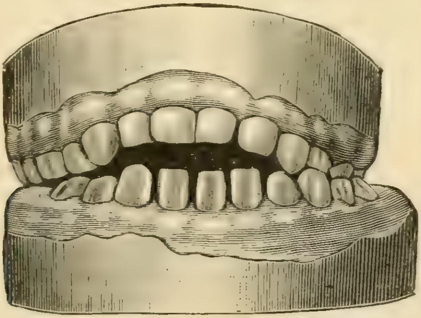


Fig. 206.

affected according to the hand used, though occasionally it is found in the median line.

As the child usually discontinues the habit before the time of the eruption of the permanent teeth, deformities produced by thumb-sucking are usually confined to the temporary set.

In Fig. 205 is shown the forward movement of the right central and lateral incisor. The model was taken from an impression of the teeth of a little girl two and a half years of age. While in the act of sucking, the right arm rested upon the breast and the ball of the thumb was directed against the palatine surfaces of the incisors which were carried forward. The child discontinued the habit at four. While the cutting-edges of the teeth have been slightly pressed forward and a very slight impression has been made on the alveolar process, none was made on the roots

of the teeth and consequently no deformity exists where the germs of the permanent teeth are located. After the child discontinued the habit, the teeth soon returned to their natural position, aided by the pressure from the lip. At this age absorption and deposition of bone-cells is so active that very marked deformities are frequently corrected before the temporary teeth are lost, providing the habit ceases in infancy.

In Fig. 206 is seen quite a different deformity. Here the teeth are fully developed, but a marked deformity existing at the median line. This case is that of a child six years of age. The thumb was held in the mouth so that the teeth came in contact with the thumb at right angles, preventing the develop-

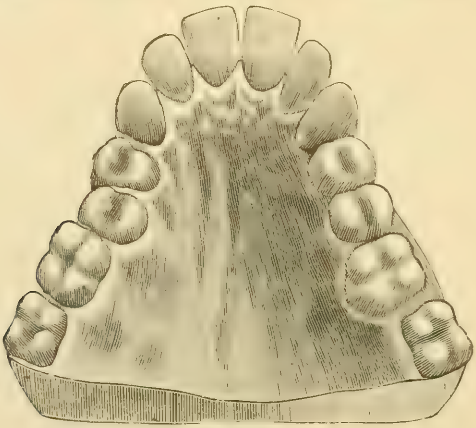


Fig. 207.

ment of the alveolar process. The teeth of the inferior maxilla do not articulate properly with those of the superior. This lack of proper articulation is caused by the thumb having rotated upon the lower teeth after the upper had closed upon them. The hard palate was flat and normal, hence the pressure was direct upon the teeth and the thumb did not come in contact with the tissues of the mouth. When the habit continues during the development of the permanent set, the deformity is more marked because there is more leverage, as is shown in Fig. 207. In the case illustrated the palate is flat and normal, showing the pressure was direct upon the teeth and the thumb did not come in contact with the tissues of the mouth. The superior jaw and

teeth are brought forward by absorption and deposition of bone-cells, and the lower teeth and jaw are carried inward.

These cases are so unlike those of any other form of irregularity of the permanent set it would seem impossible to overlook the cause. The alveolar process and teeth assume the shape of the object or thing sucked.

In Fig. 208 is shown the front view of a case of thumb-sucking. The teeth have developed their normal length. Arrest

Fig. 208.

of development of the superior alveolar process has taken place similarly to Fig. 206.

In Fig. 208 is shown quite a protrusion and forward movement of the superior incisors and alveolar process, the teeth standing fan-shaped. The lower incisors are pressed inward and crowded together. The space is greater on the right side than on the left showing the right hand was used. Irregularities of the permanent teeth, due to thumb-sucking, are rare.

CHAPTER XXIX.

THE DEGENERATE TEETH.

The evolution of the primitive tooth from the lower vertebrates and their dermal appendages illustrates physiologic processes much ignored by practitioners.

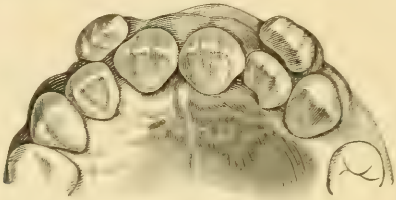


Fig. 209.

The teeth, as noted elsewhere,[1] were primitively organs of the skin which developed over the surface of the body. They became dermal bones like those which went to form part of the skull elsewhere.

The placoid scales, which were dermal teeth in the shark,

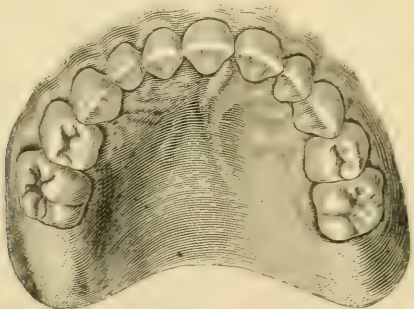


Fig. 210.

helped out the deficiencies of the brain case. In vertebrate evolution the cartilaginous scales were hardly sufficient to cover the developing brain, etc. The teeth of sharks depart from the primitive method, since they do not develop upon the surface, but deep down in the tissue. This method of tooth formation,

[1] Chapter on Development of the Teeth.

converting epithelial cells without vascular supply into enamel rods, is a degeneration in itself. A papilla forms in the dermis which eventually becomes the dentine of the tooth. The epidermis dips into the tissue below, enlarges and adds the enamel. The debris resulting therefrom, observed in animals as well as

Fig. 211.

man, is a degeneration or are "abortive rudiments" of tooth succession, as observed in sharks, some whales and reptiles. Degeneration of structure in tooth formation, however, is more worthy of attention than tooth evolution. The pulp of the tooth obtains its shape and size to form the dentine. Calcifica-

Fig. 212.

tion of dentine proceeds from the periphery, while the blood vessels and connecting tissue recede until finally when the root is completely formed a minute opening is left for the passage of an artery, vein and nerve. These not only supply nourishment to the pulp of the tooth but also to the structure of the tooth. The method of tooth formation, as compared with the original

placoid scales, is evidently a degeneration. Diseases which affect the human body necessarily affect markedly, structures so poorly nourished. Change in shape of the alveolar process and neglect to keep the alveolar process healthy causes interstitial gingivitis and endarteritis obliterans (thus preventing circula-

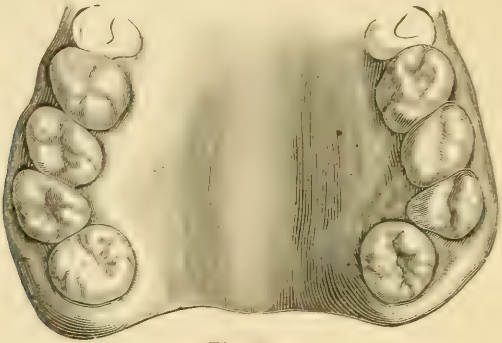


Fig. 213.

tion and nourishment of the teeth), removes the resistance, thus furnishing a suitable medium for micro-organisms.

Interglobular spaces and defective enamel formation mark tooth degeneration.

Tooth degeneration, or decay, at one period of stress (close of the first dentition) or at a period of involution (normal senility) is a normal process, for the carrying out of which osteo-

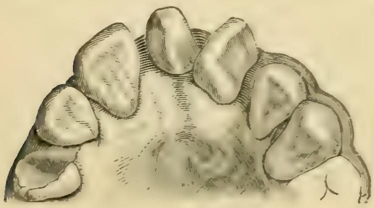


Fig. 214.

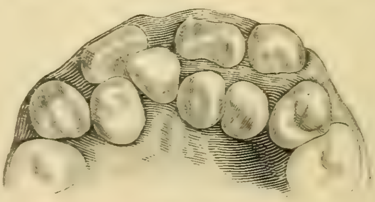


Fig. 215.

malaciary methods are provided. In polyphyodont animals this condition of tooth degeneration is normally a continuous one, since the teeth in these do not follow periods of stress.

Man at his present stage of evolution generally has twenty teeth in his temporary and thirty-two in his permanent set. Any deviation in number is the result of embryonic change occurring between the sixth and fifteenth week for the temporary teeth

and the fifteenth week and birth for the permanent. The germs of teeth which erupt late in life and are (properly) called third sets, of necessity appear ere birth, and are completely formed at the beginning of the second year, although they remain protected in the jaw until late in life.

More than twenty teeth in the temporary or than thirty-two in the permanent is hence an atavistic abnormality.

From a maxillary and dental standpoint man reached his highest development when well-developed jaws held twenty temporary and thirty-two permanent teeth. Decrease in the numbers meant, from the dental standpoint, degeneracy, albeit it

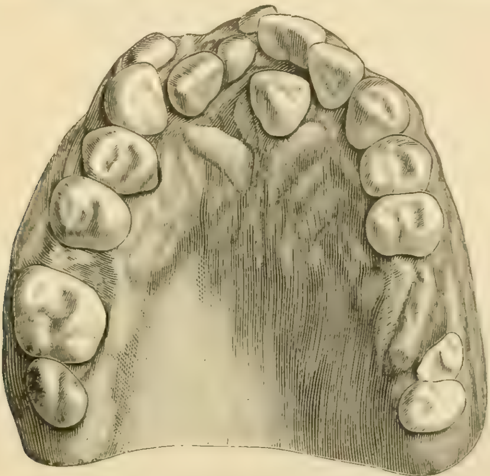


Fig. 216.

might mark advance in the man's evolution as a complete being. Marsh[2] points out that in the New Mexican lower eocene occur a few representatives of the lowest primates, such as the lemurarius and limnotherium, each the type of a distinct family. The lemurarius, most nearly allied to the lemurs, is the most generalized primate yet found. It had forty-four teeth in continuous series above and below. The limnotherium, while related to the lemurs, had some affinities with the American marmosets. A. H. Thompson,[3] in discussing the "missing teeth" of

[2] Vertebrate Life (Proceedings American Association for Advancement of Science, 1877).

[3] Dental Cosmos, 1894.

man, remarks that these researches of Marsh suggested and subsequent studies aided the solution of the problem of the origin of the extra teeth (known as supernumeraries) that sometimes occur in man. These, usually regarded as pure freaks, like polydactylism, are, however, beautiful illustrations of atavism, and demonstrate that man during his evolution from the lowest primate has lost twelve teeth. These supernumerary teeth assume two forms,—either they resemble the adjoining teeth or are cone-shaped. While they rarely are exactly counterparts, every tooth can be and is duplicated, as the following illustrations show. Fig. 209 illustrates fairly well-formed dupli-

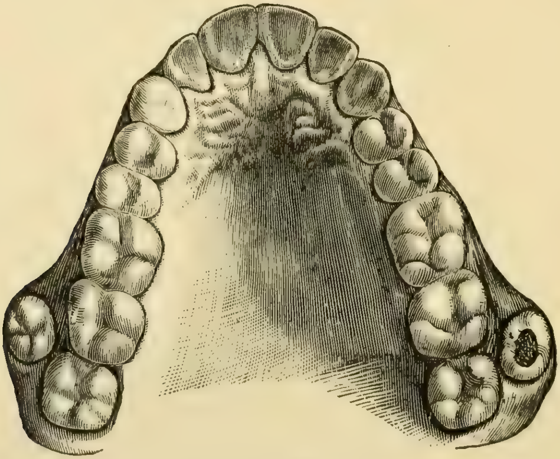


Fig. 217.

cate central incisors, the normal incisors being outside the dental arch. They are crowded laterally by the large roots of the supernumerary incisors. Fig. 210 shows an extra right lateral in a temporary set in the upper jaw; Fig. 211, an extra right lateral in the permanent set. Fig. 212 illustrates normally developed supernumerary cuspids, which are all grouped together upon the right side, the bicuspids being also duplicated on each side; indeed, all but the molars are duplicated. Fig. 213 shows supernumerary third molars easily demarcated from the normal molars. The teeth, which fail to approximate their normal neighbors, assume the cone shape of the primitive tooth.

The fact that the cone-shaped tooth, as a rule, is perfect in construction, is found everywhere in the jaw, but especially in the anterior and posterior part of the mouth, is of much value in outlining tooth and jaw evolution, especially from degener-

Fig. 218.
Smale and Colyer.

acy aspects. The upper jaw being an integral part of the skull and fixed, is of necessity influenced by brain and skull growth, hence degeneracy is more detectable in it than in the lower.

The evolution of the jaw is towards shortening in both directions. This shortening will continue so long as the jaw must be

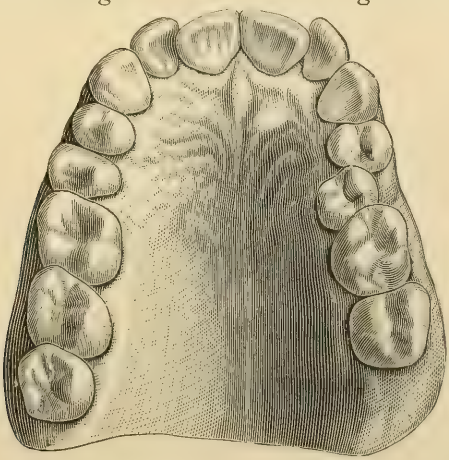


Fig. 219.

adjusted to a varying environment. The jaw of man having originally contained more teeth than at present, lack of adjustment to environment produces from the shortening, degeneracy of the jaw and atavism of the teeth. While this may coincide

with general advances of the individual, it indicates that he is not yet adjusted to his new environment. The shortening of the upper jaw causes supernumerary cone-shaped teeth to erupt in mass at the extreme ends of the jaw, as shown in the following

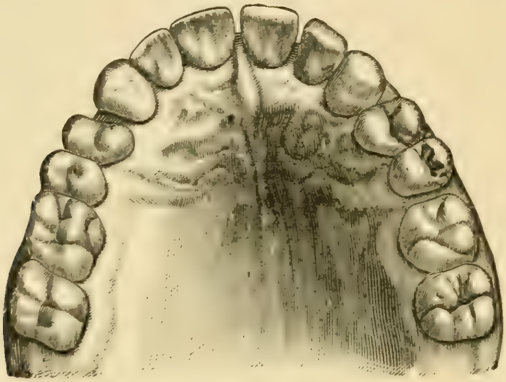


Fig. 220.

figures. Fig. 214 illustrates a cone-shaped tooth between the two central incisors, forcing them out of position. Fig. 215 shows three supernumerary teeth; a cone-shaped tooth between the central, lateral, and cuspids out of position. The left per-

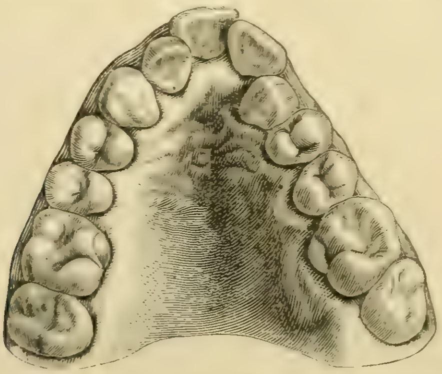


Fig. 221.

manent lateral is at the median line, another cone-shaped tooth remains in the vault, while the supernumerary left lateral is in place. As many as eight are at times to be observed in the anterior vault. Posteriorly these teeth are most often noticed

in connection with third molars, usually on a line with other teeth, posterior to the last molar. Fig. 216 shows two supernumerary cuspids in the anterior and two in the posterior part of the left arch; the molars have been extracted. Super-

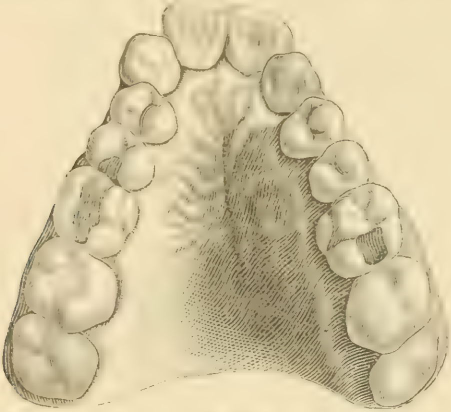


Fig. 222.

numerary teeth are not confined to these localities, but may be observed at any point in the dental arch. (Figs. 217 and 218.) The primitive cone-shaped tooth is rarely observed in the lower

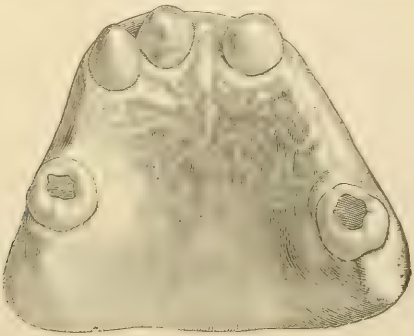


Fig. 223.

jaw. The mobility of the lower jaw prevents that maladjustment to environment present in the upper.

The continual shortening in both directions of the jaw causes the third molars frequently so to wedge in between the angle of the jaw and the second molar that eruption, if possible, is

difficult. The third molar is often absent in the Caucasian races. In forty-six per cent of six hundred and seventy patients it was missing. Frequently its development is abortive. This tooth in the struggle for existence seems destined to disappear. It is

Fig. 224.
American System of Dentistry.

more often absent from the upper than the lower jaw. When absent or badly developed the jaw is smaller, and frequently teeth irregularities, nasal stenosis, nasal bone and mucous membrane hypertrophy, adenoids, and eye disorders coexist. Fig.

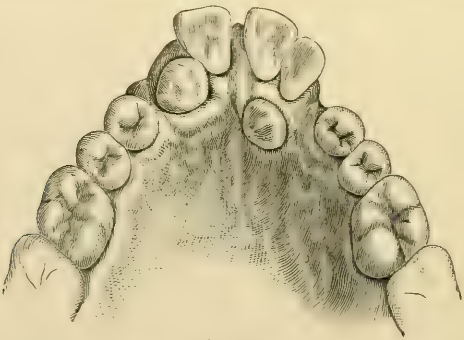


Fig. 225.

219 shows absence of the left third molar, with irregularities of that side of the arch. In Fig. 220 both third molars are seen to be missing, coincident with irregularities on both sides of the arch. Anteriorly the lateral incisors are most often wanting; fourteen per cent of the laterals were wanting in six hundred

and seventy patients. In the progress of evolution man has lost one lateral upon each side of the mouth, and the second lateral seems also destined to disappear. In Fig. 221 the left lateral incisor has disappeared, and in Fig. 222 both lateral incisors are absent. Not infrequently does it occur that centrals, cuspids, bicuspids, and even molars are absent; even their germs are not detectable. Fig. 223 illustrates a cast showing three supernumeraries in the anterior part of the mouth and but two molars. The

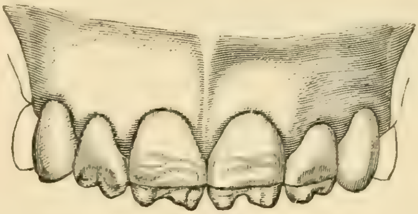


Fig. 226.
American System of Dentistry.

absence of teeth indicates lack of development of germs, due either to heredity or defective maternal nutrition at the time of conception or during early pregnancy.

Crescent-shaped, bitubercular, tritubercular, as well as all deformed teeth tend to the cone shape. The malformation of these teeth results from precongenital trophic change in dentine development. It consists in dwarfing and notching the cutting

Fig. 227.

Fig. 228.

Fig. 229.

Fig. 230.

and grinding edges of the second set of teeth, a familiar example of which is seen in the so-called Hutchinson teeth, usually referred to a syphilitic etiology. Hutchinson's position has, however, been more strongly stated than his words justify, since he admits that in at least one-tenth the cases luetic etiology could be excluded.[4]

Lues only plays the part of a diathetic state profoundly affecting the maternal constitution at the time of dentine development.

[4] American System of Dentistry.

While these teeth may be due to secondary result of lues, they do not demonstrate luetic heredity.

In Fig. 224 are seen the teeth of an individual affected with very marked constitutional disease. The degree of pitting will depend, as a rule, upon the severity of the constitutional disorder. In the case just cited, however, although nutrition was but slightly disordered, each tooth shows a tendency to conate. Not infrequently are cavities extended completely through the tooth. The cusps of the (permanent) first molars calcifying at the first year are usually attacked also and arrested in development, producing the cone shape. These data, together with dates of eruption of the temporary and permanent teeth, furnish an absolute basis for calculation as to excessive or arrested

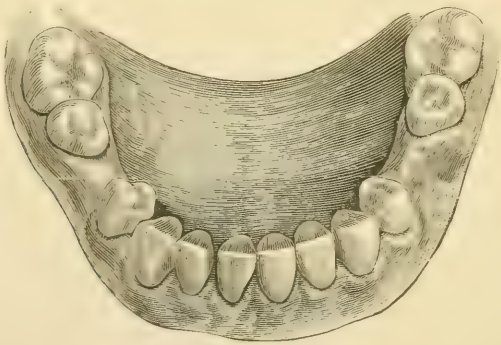


Fig. 231.

development of tissue. Fig. 225 shows a very degenerate jaw with cone-shaped malformed bicuspids. The right lateral is missing, the cuspids are erupting in the vault, and the dental arch is assuming a V-shape. The jaw as a whole shows marked arrest in development. Fig. 226 shows "Hutchinson" teeth. Were the first molars visible they would present marked contraction of the outer surface with a malformed center.

Figs. 227, 228, 229, 230, and the molars in Fig. 223 exhibit malformations, assume the cone shape, and the center frequently associated with this type of teeth. The coincidence in form between "Hutchinson" and malformed teeth and those of the chameleon demonstrates that tropho-neurotic change produces atavistic teeth. Fig. 231 illustrates the tendency of human bicus-

pids (when there is no antagonism) to rotate one-fourth round, thus again demonstrating the atavistic tendency towards the teeth of the chameleon. Fig. 232 exhibits extreme atavism; all teeth anterior to the molars are cone-shaped. The third molars are missing and would probably never erupt. In Fig. 233 appears more marked atavism. The upper and lower anterior are both cone-shaped and the superior first bicuspid exhibits a tendency thereto. The right superior second bicuspid, second

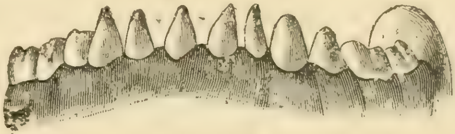


Fig. 232.
Smale and Colyer.

and third molars, the right inferior first and second bicuspids, second and third molars are missing. The same condition probably exists on the left side. The space in the upper jaw is due to the insufficient width of the teeth. Alternation of teeth in the upper and lower jaws is a reptilian feature. Fig. 223 furnishes an excellent illustration of the principles hereinbefore advanced.

In degenerate jaws the influence of the factors of the differ-

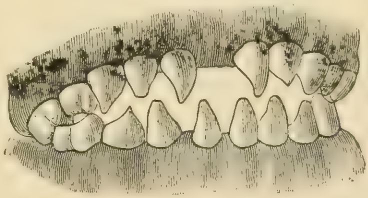


Fig 233.
Smale and Colyer.

entiation theory are also demonstrated. Every tooth in the jaw at one point or another may display rudimentary cusps. On the incisors they are always to be found on the lingual surface.

Fig. 234 illustrates the centrals with two rudimentary cusps, the laterals with one and the cuspids with one also. Fig. 235 represents cusps upon the lingual surfaces of the molars. The cuspids are not unlike the lower bicuspids with a rudimentary lingual cusp.

Thompson remarks that there is a gradation from central

incisors towards the bicuspids in evolution. This grading of form is not observed in the passage from the cuspid to the bicuspid in man. But it should be remembered that the cuspid often presents a cingulum on the lingual face that inclines it towards the bicuspid forms in lower mammals, like the mole, and that the first premolar or bicuspid is then more caniniform, the inner tubercle being much reduced. This inner tubercle is very variable and erratic as to its position. It appears as far front as the centrals and is often present on the lingual face of the laterals of man. The lingual tubercle is very constant on the first bicuspid of man and is well developed as the buccal. But in some lower forms, as in the lemurs, it is quite deficient.

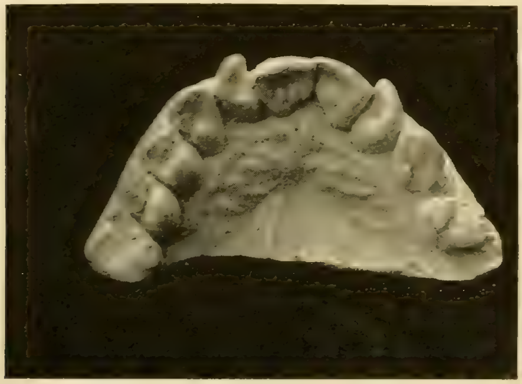


Fig. 234.

It attains the highest development only in the anthropoids and man. Considering these stages of development, the grading from the cuspid to the bicuspid forms was more gradual in the earlier species than in the later, where the individual teeth have taken on special development.[5]

The skull of a degenerate girl, who died from tuberculosis at thirteen years, has, among other stigmata, a cusp on the external surface of a right inferior cuspid. This is a decidedly strong point in favor of the differentiation theory. Another strong point in favor of this theory occurs in Fig. 236, where

[5] Dental Cosmos, May, 1894.

every tooth is present and a most remarkable display of cusps occurs. The cusps upon the cutting and grinding edges are not obliterated. Commencing with the left superior central incisor three cusps are present with a rudimentary palatine cusp. The laterals also show three cusps, while the cuspid has two very distinct. The first and second bicuspids have tubercular cusps, they being in line. The buccal cusps upon the molars two to three and are still in position. The palatine cusps are worn away. The same is the case upon the opposite side except that

Fig. 235.

the cuspid has cusps that have fused together, leaving a small projection upon the mesial side and a rudimentary palatine cusp. The cusp upon the third molar is lost. In another case (Fig. 218) the primitive cone teeth are seen trying to shape themselves into incisors. The lateral incisors, cuspids, and bicuspids are still cone-shaped. The first permanent molar is fairly formed, while the second molars are still in a primitive condition. The points made by Osborn are fully demonstrated in the two last illustrations,—namely, the triangular-shaped crowns and the levelling of cusps.

There is abundant evidence to show that degenerate teeth unite in twos, threes, fours, and fives, as indicated in the concrescent theory. These single cone-shaped teeth grow together and form bicuspids and molars. The germs of any two normal teeth may intermingle and unite; not only are the crowns found united with separate roots, but crowns and roots are united throughout.

Figs. 237 and 238 show two superior central and lateral incisors joined together throughout the entire length of crown and root; Fig. 239, two lower incisors are united throughout;

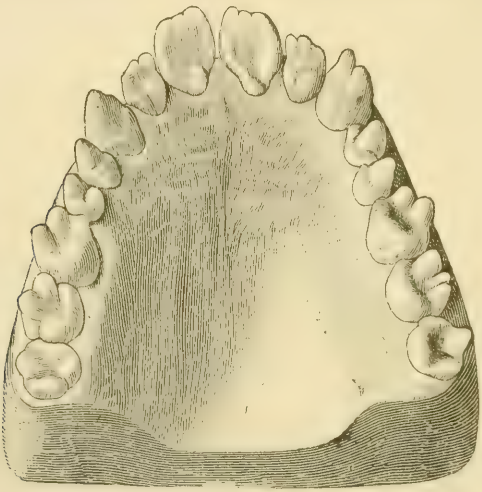


Fig. 236.
Smale and Colyer.

Fig. 240 shows a cuspid with two roots; George T. Carpenter, of Chicago, has a right superior second bicuspid with three well-formed roots; Fig. 241 illustrates two bicuspids united at the crowns; Fig. 242 shows two molars perfectly united; Fig. 243 illustrates central and lateral incisors of the permanent set perfectly united; Fig. 244 shows two molars united; Fig. 245 a molar and supernumerary united, the supernumerary taking the cone shape with deformed center. Fig. 246 shows three malformed teeth, each conated and completely united.

It is not uncommon to find three molars united together, as for instance the second, third, and supernumerary molar. C. V.

Rosser, Atlanta, Georgia, has two small molars and a supernumerary cuspid perfectly united from crown to root, and these three further united to the roots of a well-formed molar. Thus we see the concrescence theory is fully established.

A condition of molar tooth occasionally observed in America, but more often in England, Scotland and Ireland, is that where the crown is flattened from side to side (Fig. 247) and the roots nearly or quite on a line. Instead of being normal like Fig. 248, they stand like Fig. 249. These teeth are generally observed in jaws of arrested development. The third or last molar, be it second or first, is usually affected.

Dr. S. H. Guilford was the first to call attention to this particular anomaly in the American System of Dentistry, page 416, under the heading, "Compressed or Flattened Crowns." He says, "among the anomalies of tooth structure or formation this

Fig. 237.

Fig. 238.

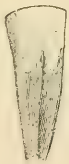


Fig. 239.

Fig. 240.

Smale and Colyer.

one is quite rare. The crowns of this character are flattened in an antero-posterior direction, so that their diameter transversely of the jaw is by far the greater one. The fissures or culci, instead of presenting the usual form, are distorted and sigmoid in shape, corresponding with the long diameter, while the cusps resolve themselves into narrow ridges somewhat after the manner of the molars of the Ruminantia. The third molars of the superior arch are the ones usually affected, although the writer has seen one case in which the superior first molar presented the same condition."

William Booth Pearsoll,[6] of Dublin, Ireland, called the attention to this abnormality at the 1888 meeting of the Royal College of Surgeons, Ireland. The question arose in connection with extraction, since there was difficulty in seizing the tooth with the forceps because of the shape of the crown and roots. These

[6] Dental Review, Jan. 15, 1899.

teeth are usually found in degenerate jaws. Like most dental abnormalities observed in degenerate jaws these teeth are atavistic, reverting in crown and roots to the original "triconodont" type with cusps and roots in line. The roots are sometimes separated, containing two or three, or there may be only one flattened upon the sides.

In degeneracy are peculiarly well illustrated the operation of the law of economy of growth producing arrested and excessive development as seen in edentulousness and excessive dentition.

As Darwin points out, hairless dogs have imperfect teeth. Here the dermic defects affected the animal as a whole; other organs profiting by the deficiencies of the hair and teeth. In most cases of hairy men, there is, as Magitot remarks, defective or irregular dentition. Here the struggle for existence, (which

Fig. 241.

Fig. 242.

Smale and Colyer.

has been between the teeth, which are derived, as elsewhere shown, originally from the skin,) is now between the teeth and the hair. In the case reported by Thurman, a man fifty-eight years of age, who was almost devoid of hair all his life, possessed only four teeth. His skin was very delicate. There was absence of sensible perspiration and tears. The skin was peculiar in thinness, softness and absence of pigmentation. The hair on the crown of the head and back was very fine, short and soft and in quantity about that of a three-months infant. A similar condition existed in his cousin-german. In a case reported by Williams, a fifteen-year-old girl had scarcely any hair on the eyebrows or head and was destitute of eyelashes. She was endentulous and had never sensibly perspired. "Jo-Jo," the famous "Dog-man," had very defective teeth. Borelius found atrophy of all the dental follicles in a woman of sixty who had never possessed any teeth. Fanton-Touvet saw a boy of nine

who had never had teeth. Fox reports a woman who had but four in both jaws. Tomes cites several similar instances. Hutchinson reports a child who was perfectly endentulous as to temporary teeth but whose permanent teeth duly and fully erupted. Guilford describes a man of forty-eight congenitally and permanently edentulous, who had no sense of smell and almost without taste. The surface of his body was covered with fine hairs. He had never had visible perspiration. Otto observed two edentulous brothers.[7]

Excessive dentition shows itself in many varieties. Those which constitute return to the polyphyodontia of the lower vertebrates. O. Hildebrand, of Gottingen,[8] Germany, in 1889 reported the case of a child of twelve which, after various oper-

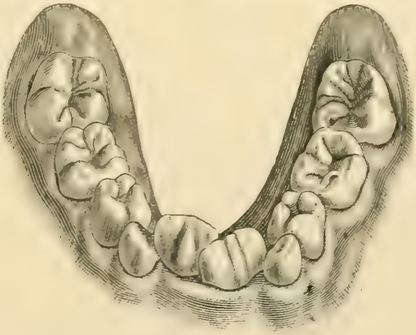


Fig. 243.

ations, had been relieved of about two hundred teeth of various sizes. Two years later (July, 1891) the patient came under observation[9] at the Gottingen Surgical Clinic. Both sides of the lower jaw were much thickened, as also was the right upper jaw. There were found seventeen teeth, part of them normally developed, others in an undeveloped condition. Their position was deviated and irregular. From the upper and lower jaw there were again some masses of teeth removed (which had the same conformation as those described in 1889), which represented about 150 teeth. There were also found two round, glassy bodies about the size of two peas, which upon microscopical

[7] Gould's Anomalies.

[8] Medical and Surgical Reporter, July 15, 1890.

[9] Centralblatt f. Chirurgie, 1892.

investigation showed tooth structure. This is a return to polyphyodontia from arrest of development very early in fœtal life. Beside the supernumerary teeth elsewhere described, arrests of development producing excessive dentition may evince themselves in double rows and in anomalous position. In the Paris Dental School Museum are several milk teeth both of the superior and inferior maxilla fused together. Bloch cites a case where there were two rows of teeth in the superior maxilla. Hellwig has observed three rows of teeth. The Ephemerides contain an account of a similar anomaly. Teeth have been found, as Gould points out, in the nose, orbit, palate and exceptionally, as in a case reported by Carver, they may grow from the lower eyelid. In Carver's case the number of deciduous teeth was perfect. Although the supernumerary tooth was canine it had a somewhat bulbous fang. Arrest of development

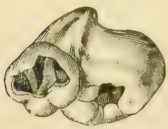


Fig. 244.

Fig. 245.

Fig. 246.

proceeding from checked development at the senile period of fœtal life may evince itself in senility of the alveolar process, as in a case reported by Bronzet, where a child of twelve had but half its teeth, the alveolar process having receded as in age.

Such arrest of development may also produce polyphyodont conditions in the human being. Catching[10] reports the case of a girl who had all her teeth at six months and shed these at nine. At fifteen months she had a full set once more. In six weeks thereafter these were shed. At thirty months she had a full set again, which remained until her fourth year, when came another set. These remained until another set began to erupt at eleven and became the permanent set complete at fifteen.

The homology of the dental tissues with the tissues of the derm, already pointed out, and the special identity of the enamel with the extra vascular appendages, render it certain, as A. H.

[10] Boston Medical and Surgical Journal, July 10th, 1887.

Thompson,[11] of Topeka, Kansas, points out, they are governed by the same laws, subject to the same influences, and possess the same phenomena of character as the allied tissues. Community of origin and similarity of structure and nature necessarily establish identity of the manner of life, of the methods of maintaining life with its varied phenomena of similarity of

Fig. 247.

service rendered to the economy and of the process of dissolution and expulsion from the system. The relationship and homology of the teeth with the derm and its varied appendicular productions are established by demonstration. These can well be and yet preserve the unity of character, which they do not fail to do. Teeth, spines, scales, dermal plates, feathers, nails, hair, bristles,

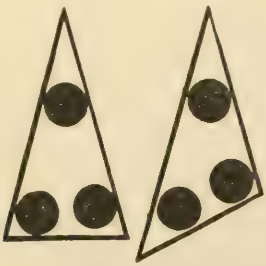


Fig. 248. Fig. 249.
Dental Review.

horn, hoof, etc., varied in form and apparent purpose as tissues can well attain, are yet closely related in structure and function, with variations, of course, within certain limits.

The enamel consists of calcified epithelial cells elaborated for the endurance of an appointed work and service in the economy. Enamel, like epithelium and all corneous structures,

[11] Dental Cosmos, Vol. 19, page 237.

yields, as A. H. Thompson remarks, keratin. In such unstable structures in evolution as the teeth, arrest of development would tend to produce for this reason, in place of enamel, horny structures. Indeed, this occurs physiologically in certain vertebrates. In that oviparous mammal, the duck-bill (ornithorhyncus), true teeth appear in the embryonic state to give way later by what Thompson calls suppressive economy or the degenerative results of the struggle for existence between the organs, to horny structures. The same condition must have appeared when the toothed birds began to lose their teeth in the tertiary. Arrests of development in man may, therefore, produce what is seemingly a reversion to this condition of the duck-bill. As has already been pointed out in the chapter on Developmental Neuroses of the Face, neurotic cases occur in which, from arrests of development, there is very little enamel upon the teeth.

CHAPTER XXX.

SURGICAL DIAGNOSES.

In all branches of medicine and surgery, the patient rather than the symptoms requires treatment. In dealing with treatment, the origin as well as the symptom requires examination. To remove the symptom without ascertaining its cause is to fail utterly in the main object, the removal or amelioration of the disorder. More disrepute has fallen upon dentists from this cause than upon general surgeons, since the latter make an attempt to deal with the patient's disorder from the side of its causation. It is equally important, therefore, for the dentist to look beyond the mouth for the origin of the disorder therein found.

Frequently when a case of irregularity is presented, the general contour and profile of the face will show whether the case be one of constitutional type, the external proportions being affected by a decided V-shaped arch, excessively developed alveoli or underhung jaw. The first thing a dentist should learn are what constitutes a normal face and jaw in a given individual and how to observe carefully. In determining correctness or incorrectness of the outline of the mouth and jaw he instinctively takes it in as a whole on the same principle that when looking at a portrait he decides it a likeness but reserves judgment on details.

Observe each jaw. See if it have a normal outline or belongs to the V or saddle-shaped variety. Notice the vault and alveolar processes. Examine the occlusion, letting the patient open and close his mouth slowly. No detail must go unnoticed. The beginner should familiarize himself with the individuality of teeth as to class, outline and occlusion.

When there is asymmetry of the upper and lower jaws, occlusion from the cuspid back is usually wrong. In such cases it generally strikes in front of the lower cuspid instead of between it and the bicuspid, disarranging the articulation of every tooth back.

The difficulty in local irregularities is, as a rule, readily detected. It is either found in the alveolar arch or the malposition of the individual teeth.

The first inquiry should be into the family history. I cannot agree with Kingsley "that it is useless to try to correct an irregularity peculiar to a family type, nature reverting to her original design, notwithstanding long-continued efforts." I have shown elsewhere (especially in America), owing to changes in climate, food and marriage with different nationalities, the shape of heads, faces, and jaws will change from one extreme to the other in four generations. Again evolution in face and jaw forms goes on so rapidly that the tissues are too unstable to present fixed forms of jaws. In a general way, it can be said there is no such thing as family type in relation to jaws and teeth. While it is possible (as I have elsewhere shown) for the child to inherit a family type of face, still irregular teeth cannot be said to be an inheritance, since order and manner of their eruption and position assumed are purely mechanical. There are never two irregularities alike. It is oftentimes well to wait until the patient is of an age when the permanent type of jaw can be determined. Tooth regulation before that period is in many cases a very unsatisfactory operation. Every case can be modified and thus be made less unsightly. Knowledge of evolution and its reverse phase degeneration, as well as heredity and atavism, are necessary factors in the skill of the operator. The first examination should be supplemented by a study from the model.

In prognosis, extent of deformity must be taken into consideration. Many cases will be corrected without interference. Cuspids and bicuspids not infrequently erupt out of position, but gradually find their proper places.

During the second dentition deformities are common, while some deciduous teeth remain in position. Difference in size of the two sets of teeth and consequent mal-occlusion alarm those not familiar with these deformities; here time will harmonize.

Caution should be exercised in statements as to the ease, difficulty of correction or the time required. Many cases which seemingly present no difficulty often give much trouble, since the resistance cannot be determined. Time spent in careful

examination of the case is well spent. Haste here, as elsewhere, makes waste. Every particular in the deformity must be studied. The dentist must forecast in his mind appliances to be used, the different steps to be taken and time required before prognosis can be given with approximate exactness.

Approximately the best time for interference is from the twelfth to the fourteenth year. At this time—the transitional period between childhood and puberty—all of the teeth are erupted, general nutrition is most active, the osseous system is in constructive stage and formative processes are in operation. Where maxillary arrest of development is present, arrest or retardation in completion of the root may result. The roots not fully developed are more or less loosely confined within the alveoli. The apical foramina are large, which lessens liability of blood supply impairment and consequent destruction of the pulp.

Since the conditions existing between the twelfth and sixteenth year are coincident with the completion of tooth eruption the converse holds true. Hence where the teeth are fully erupted, the dentist may operate, irrespective of the age of the patient.

The chances for perfectly satisfactory results in regulating decrease yearly after puberty and after twenty-six are very meagre. At this time the entire osseous system is fully developed. An unusual amount of force is required to set up inflammation and absorption. It is possible to regulate deformities as late as the thirtieth year. The resulting pain is, however, so severe and the mechanical force necessary to produce absorption of the obstructive portions of the alveoli so great that the results hardly justify the procedure. When regulated so late in life, retentive and corrective plates must be worn for years, until ossific material has formed to retain the teeth in place.

Sometimes in late correction, especially when extensive operations are performed and absorption of the alveolar process is not followed by compensatory ossific deposit, mechanical interference produces chronic inflammation of the peridental membrane (a veritable interstitial gingivitis), and later excessive absorption of the gums and alveolar process. This condition is noticeable in the mouths of patients who have had extended

and it may be said ill-advised operations. If the teeth must be regulated at this period of life, the operation should be done with great care. The patient should be impressed with a doubtful prognosis. The alveolar process is a transitory structure. It is present simply to hold the teeth in place. The alveolar process is removed when the teeth are extracted or from irritation, auto-intoxication or senile absorption. Hence the older the patient, the less the chances are for a restoration. When the patient insists upon an attempt at regulation and is willing to assume responsibility of failure, dentists may, perhaps, be justified in operating in any case of reasonable age.

Physiologic process of regulating teeth differs from repair in fractures. Repair, under favorable conditions, is possible even in advanced age. In the osseous system two parts of homogeneous structure are united. This is not the case in correcting an irregularity. Here the tooth root, a dense structure, is enclosed in the spongy structure of the alveolus. Alveolar nutrition is very active during the first and second dentition until the roots are perfectly formed and to the twentieth year. After that, blood supply being less, waste and repair do not go on so rapidly when the alveolus is injured. Lowered nutrition is sometimes shown in the separation of teeth and recession of gums, in rapid wedging as well as in interstitial gingivitis. The fact that the attachment of a tooth to the alveolus late in life cannot be compared to the union of a fractured bone is evident in the aptitude of teeth, where regulated, to return to their original place unless kept in position for some time by an appliance aided by proper occlusion. The new tissue is not as strong as the original tissue, while the bones and cicatricial tissue are practically of the same strength.

The general health and constitutional peculiarities of the patients require attention. As the majority of cases for regulation are found in youth, the state of general health is of no slight importance. The most favorable period for operation is, unfortunately, one of the most critical in the life of the patient.

From the age of twelve, the beginning of one of the most important periods of stress, the rapidly-growing boy or girl is subjected to many physical changes, entailing profound disturbances of the trophic nervous system. Prolonged and injudi-

cious worry, over-study, over-exertion, impure air, improper food, sexual irritation, auto-intoxication, as well as other disturbing factors tend to become prominent in the life of the patient.

Sexual disturbance is of especial importance on account of the periods of stress. When to physiologic perturbations of this important period of evolution are added influences of environment, perversions of nutrition, like rachitis and allied states, consequent upon congenital weakness, improper dietetics, hereditary syphilis or the exanthemata, the importance of taking into account the influence of the general health upon operative procedures is self-evident. Operation on young persons in delicate health should be deferred until the constitution has improved. Dentists must recognize these general conditions, so that they may be properly treated. Many patients requiring correction are children with unstable nervous systems, whose physical development departs from the normal. The mucous membranes are badly developed, digestion and assimilation are faulty. The glandular system is weak. The excreta are not properly eliminated. From an undeveloped nervous system, strain at this period is often attended with disastrous results. Not infrequently in such patients later in life, it is found that the alveolar process has not been restored. Interstitial gingivitis sets in early, the teeth loosen, separate or crowd together, elongate and are finally lost.

Patients that present themselves are, unfortunately, mostly neuropaths and degenerates. This increases the danger from careless procedures. Here assimilation of the patient must be normal. The patient should be given enough unstimulating nutritious food suited to his particular case. It is often difficult to do this, since the appliance hinders mastication. The patient should have abundance of sleep in a well-ventilated room. He should be in the open air as much as possible. The mind should be placid and agreeably occupied so as to aid him to forget the irritation during the process. Absence of pain from lack of physiologic response is as great a tax on the nervous system as the pain itself. Dentists should, therefore, not be satisfied with the absence of complaint by the patient, who should, if reticent,

be encouraged to give expression to his feelings. This aids in deciding the time required for each step.

To carry out the programme it may be necessary to take the patient out of school or to diminish his tasks. Schools are generally badly ventilated. Exercise during school hours is almost impossible. These patients cannot be under routine discipline of the school room without detriment to health and spirits. School-life is a heavy tax during development. The strain of correcting an irregularity should not be added to the other cares of puberty and adolescence. Children during puberty and adolescence are morbidly conscientious, ambitious and reserved. They suffer much and say little. This is particularly true of girls, who do not find the relief boys do in outdoor play. The sights and sounds of field or wood or even the street, that furnish diversion to the active boy, are denied the girl. Her life, more circumscribed, is more liable to passive suffering. Great care is, therefore, required in the case of the girl.

In such cases co-operation of a skillful physician is indispensable. A delicate, puny woman has been invalided for two years, solely by the shock produced upon a primarily unstable nervous system from a prolonged operation in regulation. The weight of the patient should be obtained at the time the appliances are adjusted and noted and every two weeks throughout the operation.

Success in dentistry as well as in medicine depends to some extent on the mental attitude of the patient. Interaction of mind and body may be aided greatly in accomplishing an operation or may be a decided drawback.

Knowledge of human nature, quick judicious sympathy, an agreeable presence and tact are among the most valuable possessions of the operator. If the dentist work in harmony with the laws of mental and physical health, half is gained. With the aid of these qualities the more likely will he gain the co-operation of the patient and guardian.

Desire for correction depends somewhat on the social status of the patient, sex and age. The poverty stricken, even if they have a decided æsthetic sense, are so hampered with pressing considerations of a more urgent nature that little attention is paid to irregularity. With the well-to-do, the æsthetic side of

life assumes larger proportions Beauty is of the greatest importance, especially in women. Their lot in life may be materially changed by an attractive mouth. Society, taking these things for granted, acts upon them. The dentist is, hence, more likely to secure the co-operation of the child of the well-to-do. The daughter of Dives who subjects herself cheerfully to the torture of waist compression will with equal readiness and more logic subject herself to the irritation of correcting a deformed arch. The mouth, with its ample opportunity for display in repose, conversation or laughter, suffers less from the ravages of time than the waist. Mothers, usually alive to these considerations, encourage their children to endure the strain. Occasionally parents, by their indifference or careless remarks, become a great hindrance to the dentist. They do not co-operate with him by enforcing wearing of appliances and regular visits. The dentist should determine the attitude of patients and guardian before his task is undertaken, since without their co-operation his best efforts will be thwarted and his reputation suffer.

Taking the impression of the mouth and jaws is, of necessity, the first step in regulation. The position of the teeth, their relations to one another and the conformation of the jaws can be more easily studied and accurate conclusions more readily deduced. The teeth should not only be moved to their proper places, but must be in harmonious relations to one another. Otherwise, they tend to return to their faulty positions. Their normal relations can best be determined by studying the model.

The material employed in taking impressions must depend upon the shape of the jaw and position of the teeth. If the teeth be but slightly irregular or if the crowns be short and quite irregular, plaster of Paris should be used.

If, on the other hand, the teeth be irregular and long and the arch deep, plaster of Paris will be apt to adhere to the teeth. In such cases the modeling compound should be used.

Where the plaster is used the patient should occupy an ordinary chair, as the head is lower and the operator has better control of the patient. The clothing should be protected by two towels under the chin and a newspaper in the lap. An impression cup large enough to enclose the teeth should be selected and so built up with wax that it will extend beyond the margin of the

gums. The center of the cup should be filled with soft wax to conform to the palate; and the plaster will be readily carried to all parts of the mouth. The finest quality of plaster should be mixed in a bowl with sufficient water to make a mixture of the consistency of thick cream; addition of a little salt will hasten the process of setting. After stirring until the air bubbles have disappeared and the plaster has begun to set, the cup and outer edges should be filled with it.

The operator should stand to the right and just behind the patient with the left arm around the left side of the head and the forefinger inserted into the mouth. The cup should be carried to the mouth with the thumb and forefinger upon the handle and the middle finger in the center to steady it. After it has been inserted into the mouth it should be pressed into place with a rotary motion of the right hand. At the same time the lip should be raised, the cheek pressed out with the left finger. When the cup is in position, it should be held firmly with the middle finger in the center of the plate against the teeth. The head should be inclined toward the breast to prevent the plaster passing back to the fauces. Should the stomach become disturbed and vomiting ensue, it can be evacuated without interfering with the impression.

Test the plaster in the bowl or in the impression cup and when it will break with a clean fracture it is time to remove the cup, which can be done by moving the cup backward and forward with the right hand and pushing out the cheek with the fingers of the left hand to admit the air. Having placed it in the upper towel, held up by the assistant, carefully examine the mouth and if pieces of plaster be seen, put them in the towel on the proper side of the impression to save time. Set the impression carefully away, afterwards arranging the pieces in their right places.

The second towel is for the purpose of removing plaster that may remain about the face.

The operation should be explained in part to the patient, who otherwise anticipates serious experience. All these little details should be strictly attended to so as to insure perfect impression at the first sitting and save the patient the annoyance of later applications.

In taking impressions of the lower jaw the patient should sit higher, so that the mouth will be on a level with the elbow of the operator, who stands in front of the patient. The fingers of the left hand should push out the cheeks and lips while the cup is rotated into place with the right hand. The first and second fingers of each hand should rest upon the cup over the bicuspids and molars, the thumbs under the jaw on either side, thus holding the cup firmly in place until the plaster sets, which should then be removed and placed in the towel as before. After a few minutes' hardening the impression should be placed under running water to remove mucous, saliva, blood or particles of plaster. Should the plaster be broken, the pieces can be placed

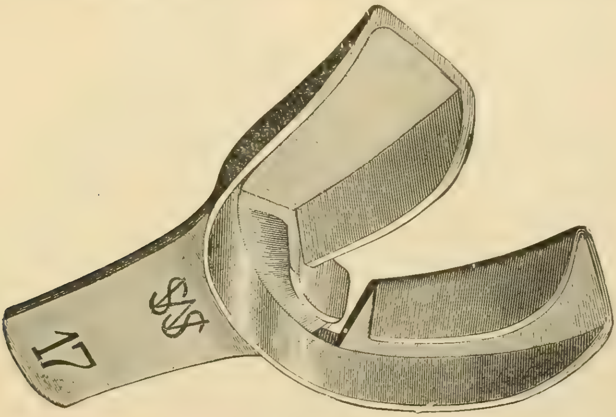


Fig. 250.

in the position indicated by the arrangement on the towel, and, when perfectly dry, fastened together by melted wax. A clean separation of the model is obtained by covering it with a lather of soap and washing off the surplus or by coating with shellac and oiling to prevent sticking.

Modeling compound is employed with success if water heated to the boiling point be poured into a bowl containing modeling compound. The compound should be inserted as hot as it can be borne. Enough should be used to cover all parts of the teeth and jaws when it is forced into place. The impression cup should be held firmly in place for a moment and a towel saturated with cold water should be carried at all parts of the

mouth to chill the compound. Impression cups (Figs. 250 and 251) should be used in cases of irregularities. The compound loses elasticity by boiling. The surface of the impressions should be oiled, thus preventing the compound's sticking to the cast.

To obtain the model, place a sufficient quantity of water in a bowl and pour in plaster, allow it to settle and thus prevent formation of air bubbles. Add enough plaster to make it of the consistency of cream. To exclude the air put a drop of water into each depression made by the teeth in the impression and add a small additional quantity of plaster. On tapping the cup upon the bench the plaster will fill up the depression with-

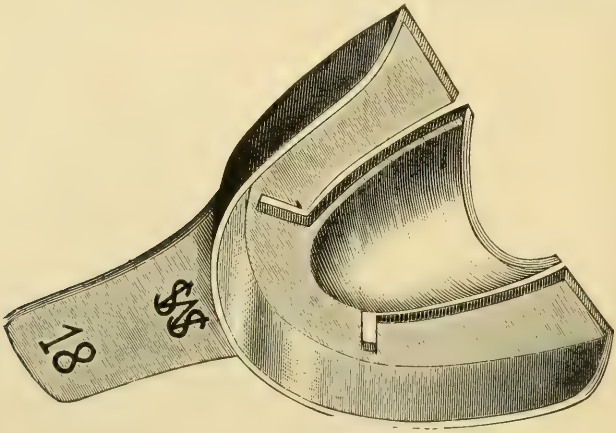


Fig. 251.

out formation of air bubbles. The surface should now be covered with plaster. After mixing in more dry plaster to make it thicken, fill the impression full and place it upside down on a glass slide. Then build out the model until even with the impression cup and allow it to harden. It had better stand from twelve to twenty-four hours so that it may be thoroughly hardened before being removed.

Having removed the impression, trim the model roughly. After articulating, trim it so that the body of the model will be parallel with the line of the teeth and made presentable for inspection. Place the name of the patient and the date of beginning operation on the surface of the lower model. The patient's

initials should be put upon the upper model. After this the surface should be varnished. A band of elastic rubber will hold them together. An articulator of brass wire (Fig. 252) may be made for holding the models in proper positions and then preparing them for easy inspection. The upper arms and spiral may be made of one piece of wire, No. 18, U. S. gauge; the lower arms from another piece of the same wire passed through the spiral and bent to correspond to the upper arms. The models may now be articulated and the wire arms bent to meet the upper and lower surfaces. The surfaces, after being saturated with water should be covered with plaster and the arms united to the model.

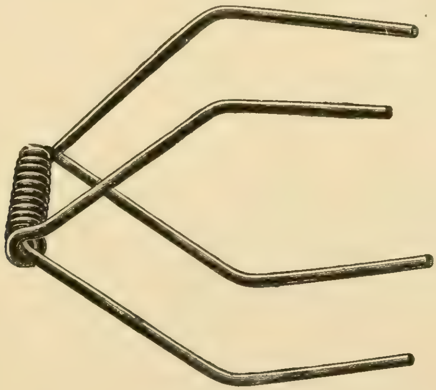


Fig. 252.

In regulating teeth a model should be conveniently placed so to improve spare moments by studying the physiologic conditions of the teeth before arriving at conclusions as to the pathology of the case. In determining the character and extent of a deformity a criterion is necessary. In the skull, on taking the two cuspids for the starting point, the arc of a circle is found. On dropping a line from the cusp of the cuspid to the center of the wisdom tooth, the posterior part is seen to diverge considerably from the central line (Fig. 253). The three normal lines of the dental arch are seen.

The incisors of the inferior maxilla should close inside of the superior incisors. The buccal cusps of the bicuspids and molars should occlude at the center line or sulci of the superior

bicuspids and molars. If the articulated skull be placed with the buccal surface toward the observer, a gentle curve downward will be seen from the cuspid to the second bicuspid, rising then until the wisdom teeth are reached. Fig. 254 shows the relative positions of the teeth in the jaw and their relation to one another. Since mastication is done principally by the bicuspids and first molars, these teeth should articulate perfectly. This is accomplished by the tooth of one jaw interlocking between two teeth of the opposite jaw, thus providing support and surface. The points of the cusps of the superior cuspids should stand at the point of occlusion of the inferior cuspid and first bicuspid.

If the arch posterior to the cuspids be uniform and these teeth be regular and articulate as shown in Fig. 254, they should

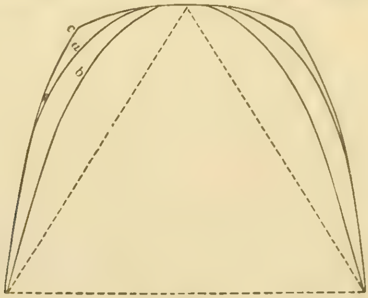


Fig. 253.
Farrar.

not be interfered with for slight deformity in any of the six anterior teeth. The cuspids may be widened laterally to make all the room needed. When this is accomplished and the deformity corrected, the teeth in the arch will adjust themselves properly. If the irregularity be complicated and more room be required than can be obtained by extending the cuspids, it is best to enlarge both arches, which will give all the space needed. The changing of a well-articulated set of teeth so that the cusps of the opposite teeth will strike is an unpardonable error.

The arch of the superior and inferior maxilla should have a diameter of sufficient width to prevent an impression of the teeth on the sides of the tongue. Any deviation of the jaws or teeth from this outline is a deformity which should receive the attention of the dentist.

With this standard in mind the model will reveal certain deformities. Careful consideration will show that one of two conditions exist; either the teeth are in a crowded and irregular condition inside of the proper line or they are isolated and irregular outside. In the majority the irregularity involves the teeth anterior to the first permanent molar. If space be wanting, the question will arise whether to enlarge the arch by force or to extract one or more teeth. The age of the patient will decide this question. If the temporary teeth are in the mouth, causing irregularities, they must be removed. When the removal of the second teeth becomes a necessity, a tooth should be selected which is the least prominent or which will least affect the expression. In selecting teeth for removal, each case must be taken as a law unto itself, requiring its own special treatment. A good rule is to retain, if possible, the six anterior teeth.

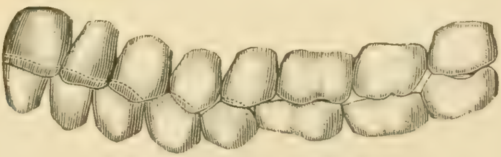


Fig. 254.

As the cuspids on the upper jaw are the most prominent and give expression to the face, they should not be removed. If a tooth must be sacrificed, the selection lies between the first or second bicuspid and the first molar.

If it be found that teeth are so decayed that the roots cannot be filled and the crowns replaced with artificial ones (at the age of twelve or thirteen years, the first permanent molar is often decayed) those affected should be extracted. This was the case in the upper teeth of a girl fourteen years of age (Fig. 255). Here the bicuspids had advanced so far forward that there was insufficient space for the cuspid to come down into place. Upon examination it was found that the first bicuspid upon the left side and the first permanent molar upon the right side were badly decayed. It was easy to decide which teeth should be sacrificed. The cuspid upon the left side came into place with-

out assistance. The bicuspids upon the right side were carried back and the right cuspid came into place. The first permanent molar has most often been extracted without sufficient cause. Since this tooth serves an important purpose in mastication on account of its broad surface and large long roots, it should be retained if the crown be in a fair state of preservation. It has served for six years, which fact, in connection with its solidity in the jaws and its central position, argues for keeping it.

Upon examining the models, it is occasionally found that the articulation posterior to the cuspids is perfect, nearly approximating the centrals and the laterals locked inside or outside of the arch. Whether sound or decayed, it may be best in such

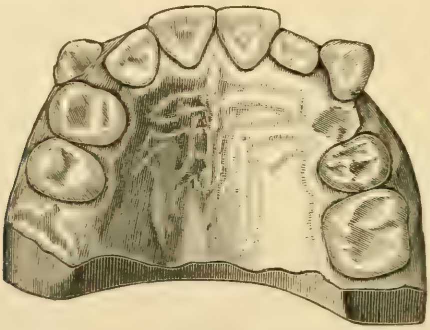


Fig. 255.

cases to remove one or both laterals. The general appearance of the teeth will not be injured by this treatment. Dr. Guilford[1] describes two cases of this kind presented to him in one year for the reduction of prominence in the superior front teeth. In each case there was a broken or badly diseased right central that was past hope of redemption. In these cases it did not happen particularly amiss, since extraction of the roots afforded room for drawing in the remaining five teeth, thus easily reducing the deformity and at the same time closing the space made by their loss. The appearance of the patient in each instance was greatly improved. The absence of even so large a tooth as the central was hardly noticeable.

[1] American System of Dentistry.

In another case, a girl eleven years of age had lost a right superior central incisor through a fall from a swing. Two days after the accident and when the tooth had been mislaid or thrown away she was brought for treatment. Two methods of remedying the difficulty suggested themselves to Dr. Guilford. One was wearing of an artificial tooth, the other drawing the teeth together to close the space. The latter plan was successfully carried out. Unfortunately, as there had been no protrusion formerly and as there was contraction afterward, the superior teeth no longer overlapped the lower ones but met them edge for edge, thus giving the upper jaw a flattened appearance, in itself a deformity. The patient was saved the annoyance of wearing an artificial tooth, but her facial expression was injured in consequence. In the large proportion of cases, where the anterior teeth are crowded and the cuspids are too far forward or are outside or inside of the arch, the first bicuspid should be extracted on one or both sides. Removal of these teeth gives sufficient room. The operation is not prolonged as would be the case were the second bicuspids or first permanent molars removed. In this way the anterior teeth can be brought into place with little or no extra space.

Irregularities of the lower teeth, especially of the inferior incisors, are often seen. If the articulation be normal in the posterior part of the mouth, almost any of the incisors that are out of position may be removed. They resemble each other so closely in size and shape and are so nearly concealed by the lip their loss will not be observed. The operator should be particularly careful in deciding the mode of treatment, since an actual increase of the deformity may be produced by a hurried operation. In one case, a girl of ten years of age, a central incisor was removed and the muscles of the lip together with lateral pressure of the adjoining teeth pushed against the cuspids, forcing the incisors into a crowded condition, thus producing a V-shaped arch. It was ascertained that the articulation of the posterior teeth was not perfect. It has been advised to remove a corresponding tooth on the opposite side, where want of room compels the removal of a tooth in the anterior part of the mouth. It is claimed that there is danger of the incisor moving by the median line when a tooth from one side only is

extracted. It has been found, however, that when a tooth is removed back of the cuspids the lateral pressure is seldom sufficient materially to move the incisors. Cases occur in which the cuspids on the lower jaw may be removed without injury to contour or appearance. It is frequently better to do this than to extract a lateral incisor or first bicuspid and try to bring the cuspid into the arch. The bone is so dense that unusual pressure is required to produce absorption. This can be done, if necessary, by cutting away the alveolar process and by the use of screws.

In considering the bicuspids the one which is the most decayed should be removed if, by so doing, their irregularity can be corrected. Care should always be exercised in examining the occlusion before a bicuspid is extracted. In one case where

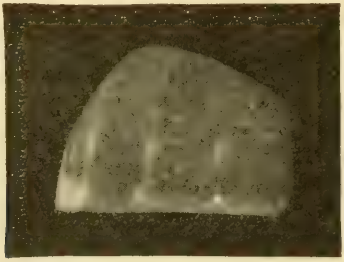


Fig. 256.
Kells.

the two upper second bicuspids were extracted with a view of relieving the crowded condition of the anterior teeth, the articulation of the first bicuspids was such that adjustment was impossible. These perfectly interlocked with the lower teeth. No relief followed and the only way to correct the blunder was to move the first bicuspids back. The mistake had been made by following blindly what was vaguely supposed to be the rule without considering the requirements of occlusion.

If both bicuspids be found sound, then the first should be chosen if the anterior teeth are crowded. This makes room for the cuspid. In studying the model, the end to be kept in view is the retention of the teeth in place after they have found their new position and are so properly articulated that they will hold one another in place. If this be not accomplished the action

of the cusps will force the teeth into their original faulty position.

Nowhere in medicine is diagnostic use of the Roentgen ray of so much importance as in dental deformities. Delayed eruption, early extraction, abnormal and broken roots of teeth, location and position of third molars, absorption of the roots of teeth and of the alveolar process around the roots can easily be outlined. All of these lesions more or less affect occlusion and impair mastication. Before the X-ray it was impossible, as is now done, to outline impacted and imbedded teeth.

When the permanent teeth are missing or have not erupted, I usually cut down upon the locality and explore for missing teeth. This is easily done and with very little pain to the patient. To outline direction and contour of the tooth is difficult, however.

From arrest of development of the jaw, roots become entangled or fused together, as in the case of the cuspids and second and third molars. Here it is often difficult to determine the best course. By the X-ray, lancing, probing and packing cotton are avoided. By the X-ray the parts are shown in exact outline of the tooth, its root and their relations. The necessity for operations upon the teeth is thus earlier seen and the operation expedited. Frequently the permanent teeth are prevented from erupting for want of room. In such cases the delayed tooth can be assisted by extracting or otherwise making room.

While it is comparatively easy to obtain perfect skiagraph of other parts of the body, it is as yet somewhat difficult to obtain good skiagraphs of the jaws and teeth. The reason is the difficulty of keeping the parts quiet during the process of placing and retaining the plate films in proper position in the mouth. In certain parts of the mouth, such as the molar and bicuspid region of the lower jaw, success is greater. With the anterior teeth, those of the upper jaw, success is obtained with difficulty. If, however, the vault be high much better results can be obtained.

The best work that has been as yet accomplished is that done by Dr. C. Edmund Kells, of New Orleans, Dr. J. N. M'Dowell, of Chicago, and Dr. Dwight M. Clapp, of Boston.

Dr. Kells'[2] method is as follows: "A cast is made of the portion of the mouth to be skiagraphed and a small piece of modeling compound molded over the crowns of the teeth thereon. A piece of aluminum, this metal being almost transparent to the rays, of about 26 or 28 gauge, is cut to the desired size and shape and bent to fit the cast as well as possible. This is slotted along the edge toward the crowns of the teeth and thereby attached to the modeling compound above referred to. This forms a convenient little film holder, which when placed in the mouth will allow the patient to close the teeth upon it and thus hold it securely in position, without danger of its moving for a much longer time than is necessary to take the picture.

The next step is to cut the plate or celluloid film, whichever

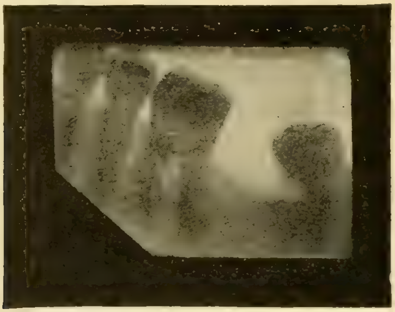


Fig. 257.
Kells.

is to be used, to the proper size and envelop it neatly in black paper, gluing down all the edges with paste and securing it to the plate holder by two or three small aluminum clamps.

This is all that is usually necessary, but if it is deemed advisable to protect this from moisture, as is sometimes the case, more especially for lower teeth, then the black envelope is covered with thin tin foil or waterproof paper neatly pasted down, care being taken not to have the foil, if that is used, doubled upon the side to be exposed. While this may appear to be a long process, it is quickly accomplished and the invariably satisfactory results obtained warrant the trouble taken.

The patient is then seated in a chair with a photographer's

[2] Dental Cosmos, Oct., 1899.

head rest to hold the head, the Tesla screen, to be described later, put in place, the tube brought to about ten or twelve inches from the face and placed so as to throw the best shadow of the parts upon the film. The length of exposure depends upon the thickness of the parts to be penetrated, the working condition of the apparatus and the distance of the patient from the tube, the time being proportional to the square of the distance.

From sixty to ninety seconds are necessary for ordinary cases, ranging perhaps up to one hundred and twenty seconds for third molars in heavy jaws, while twenty to forty seconds are sufficient for some favorable cases in thinner bones.

Fig. 256 shows a case in practice of an unerupted bicuspid

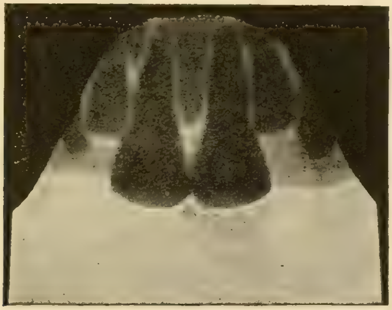


Fig. 258.
M'Dowell.

taken in forty seconds. Fig. 257 shows a case of normal teeth taken in twenty seconds."

Dr. J. N. M'Dowell recommends the following method: "In taking X-rays of the teeth it was found impossible to conveniently cut glass sensitive plates to correctly fit the different parts of the mouth without the spoiling of many plates. To overcome this difficulty, it was necessary to have something that could be easily cut and shaped to fit the mouth for each occasion and at the same time transmit light as a negative in making photographs. Celluloid prepared with sensitive chemicals has been found to answer this purpose best.

No special preparation of the mouth in the way of washes, etc., is necessary, as the plate is protected by a covering. Cut a

piece of cardboard to fit the part of the mouth that is to be photographed. In the dark room lay the cardboard on the sensitive celluloid plate and cut to the same shape. Figs. 258 and 259, etc., of the X-ray pictures show the original shape of the cut celluloid. This is then wrapped in black paper to protect the plate from light and the moisture of the mouth. The head is so placed as to be immovable and the sensitive celluloid placed in the mouth directly back of the teeth to be taken. The usual time of exposure is about a minute with Crookes' six-inch tube. This tube should be stationed some six or eight inches above and in front of the teeth to be taken, in order to secure the outlines of the roots. If the tube is held directly opposite the teeth the roots are not taken, as the plate cannot be inserted high enough, owing to the shape of the roof of the mouth."[3]

An important consideration in the regulation of teeth is the pecuniary reward. The dental specialist should have so prepared himself that he fully understands and appreciates the requirements of any case which he may undertake to correct. This will take much time and anxious thought, for which he should receive just reward. A thorough understanding as to the proper remuneration should be established before anything is done.

The models of the jaws should be carefully examined. The temperament and disposition of the patient, as well as the ossific condition of the jaws, should be considered and minutely examined. It frequently happens that mouths exhibiting very similar deformities on account of mental and physiologic idiosyncrasies and differences in density of tissue, require different treatment to accomplish favorable results. After these preliminaries have been carefully arranged as correct an estimate as possible should be made (and at the best it can but approximate) of the expense of regulation and retention in proper position.

At this juncture before operation is begun a thorough understanding should be established between the operator and the parent or guardian as to approximate cost of the work. It is well not to be too definite since it frequently happens that the operation requires very different appliances and consumes more

[3] Dental Cosmos, March, 1900.

time than was at first anticipated, in which case the operator should be rewarded for his unexpected labor. Or, the operation may be completed in a much shorter time than was anticipated, in which event a proper regard for the patient's rights should prompt a reduction in the fee. A medium and a maximum price, therefore, should be agreed upon before the operation is undertaken. Conspicuous among the difficulties which come with regulation is first to persuade the patient to submit to the annoyance of wearing the appliance; secondly, to impress upon the patient the necessity of being prompt and faithful in visits to the dentist's. Not appreciating the importance of these operations, patients, and especially children, frequently become discouraged and are anxious to abandon the treatment before it is completed. The parent too often sympathizes with the child

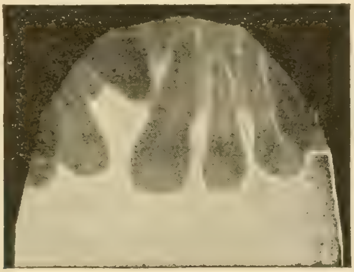


Fig. 259.
M'Dowell.

and without regard for the labor or expense which the dentist has assumed or the real interest of the patient abandons the operation. The dentist is left without remuneration, although up to this point he has carried out his part of the contract. To secure the continued co-operation of the patient and parent until the completion of the operations, it is justice to the dentist that he should demand and receive at least one-half of the proposed fee before the work is begun. With this money invested in the operation, the parent will be loth to allow the case to be abandoned before it is finished.

The dentist with due regard to the comfort and good of his patient should do all possible to expedite his operation, so that suffering and expense may be as light as possible. All should

be done with an intelligent understanding of the physiologic and pathologic conditions under care. The patient, by obedience to the dentist's instructions, can facilitate the correction, which will, of course, greatly reduce the expense of the operation. Here as elsewhere in surgery it is better not to give too minute details as to plans to be followed and the appliances used, since it frequently happens that the most carefully-planned procedure has to be varied during the operation. In this case disappointment and dissatisfaction may be engendered in the mind of the patient with a suspicion as to the dentist's ability to accomplish the results at first promised.

CHAPTER XXXI.

PATHOLOGIC AND PHYSIOLOGIC CHANGES.

The chapter upon the Alveolar Process dwelt minutely upon development and absorption in its relation to eruption and loss of the teeth, showing that the process was solely for the purpose of supporting the teeth while in place and finally, after they have been removed, it is forever lost. This structure, being transitory, the osteoblasts and osteoclasts are always present to build up or tear down structure as may be required by the exigencies of environment. The rapidity with which the cells act depends to a great extent upon the age of the individual and condition of the system. The osteoblasts and osteoclasts are necessarily more active in periods of growth. This is due largely to the vascularity and want of density of bone structure.

In the evolution of man, the face is constantly undergoing change and the jaws are growing smaller. The alveolar process being a transitory structure is necessarily unstable, hence here the osteoblasts and the osteoclasts are quickly and readily set in action. Absorption often is of slow development, but once established, light, constant or intermittent pressure makes way for the advancing tooth.

The teeth are constantly changing their positions in the jaw, absorption and deposition of bone going on simultaneously and continuously. This is particularly noticeable at the first eruption of the teeth, and again from the twelfth to the sixteenth year. When the first permanent molar has been removed, the second and third gradually press forward and fill the space.

Teeth that are erupted out of their position will, in time, often find their way back into it; when molars and bicuspids are lost late in life, the anterior teeth being forced forward, causes the alveolar arches to project. When the anterior teeth come in irregularly they rotate their way into place. Through these motions of the teeth, when assisted by mechanical devices or removal of obstructions, regulation of malposition becomes

simple; furthermore, after regulation, the teeth may be firmly retained in their relatively new positions in the alveolar process.

Application of light, constant pressure to irregular teeth, aiding their motions, will greatly increase absorption and reproduction of bone. The equable reproduction and absorption will depend upon the amount of pressure exerted and the condition of the individual, since in cachexiæ disintegration is favored, while

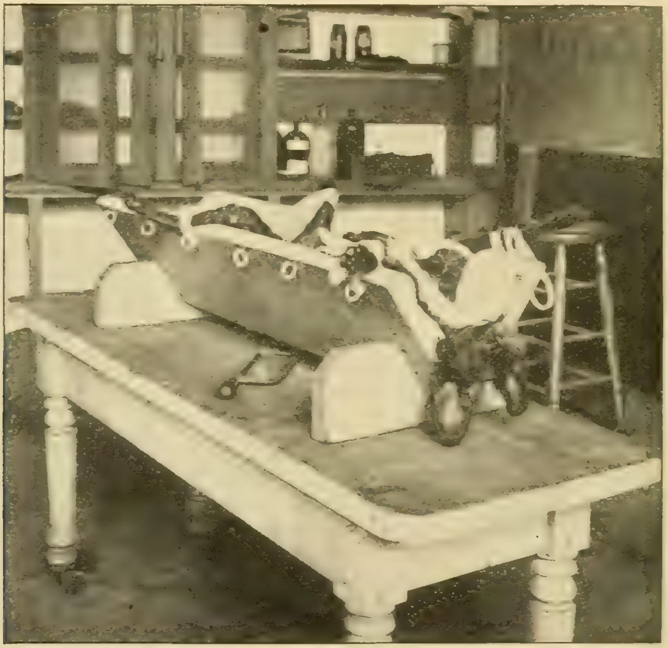


Fig. 260.

tissue building is retarded. This notably occurs in auto-intoxication and senile absorption. The degree of pressure and the constitutional condition of the patient must therefore be taken into account in operations of regulating. When the alveolar arch is widened laterally as a whole, and the force distributed widely upon both sides of the jaw, the bones yield to a certain extent, thus spacing the teeth equally in all directions. By absorption of the old and by deposition of the new bone about the teeth, they become fixed in their new position. The degree

of absorption and change of position is not always equal in all parts of the tooth. They vary with the direction of the pressure.

When force is applied to the crown and the teeth have to be

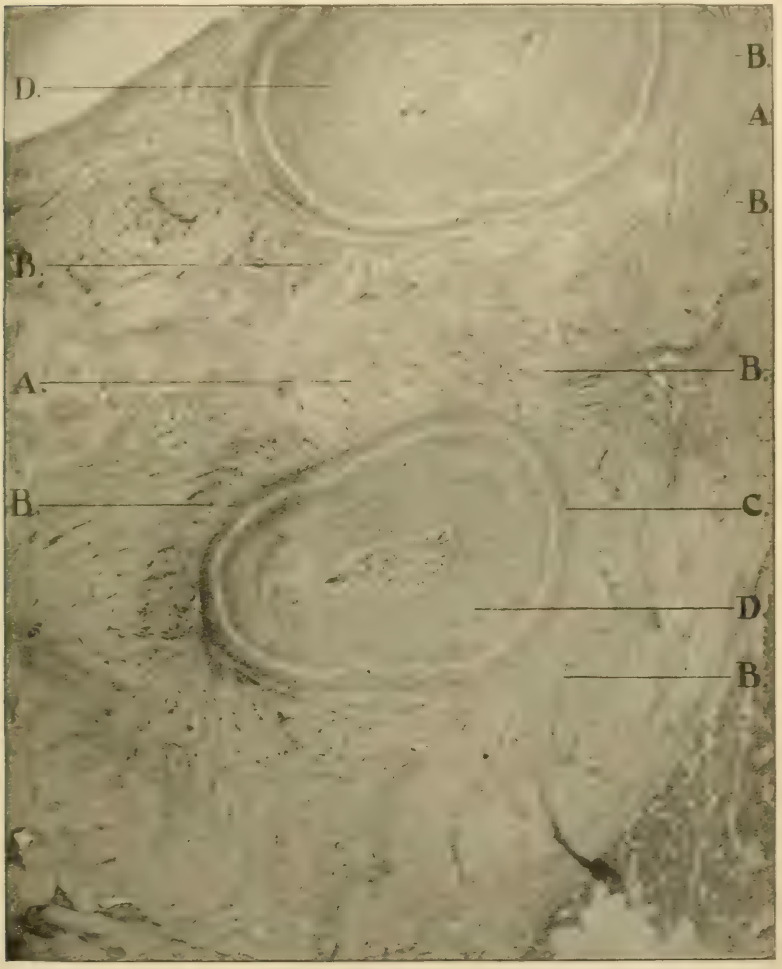


Fig. 261.
1½ inch Beck objective. Magnification about 25x.—Noyes.

moved considerably, more absorption occurs at the margin of the alveolus than at the apex. The mechanical appliance is here the power and apex of the tooth is the fulcrum. The power

necessarily acts upon the margin of the cavity in which the tooth is imbedded. The tooth may be said to move like a spoke in a wheel. The outer part of the crown travels relatively

Fig. 262.
A. A. Zeiss obj. Magnification 86.5x. ¼ turn, 7 days.

more than the inner part or apex. The gradual diminution in diameter from neck to apex must be also taken into consideration.

If the pressure be gentle, evenly distributed and constant, pain will not be experienced, when the teeth have once begun

Fig. 263.
A. A. Zeiss obj. Magnification 86.5x. ¼ turn, 7 days.

to yield in the proper direction. But when force is applied, removed and re-applied, spasmodically considerable pain necessarily results. The difference between the results of steady and

of intermittent pressure is observed every day in practice. When teeth have been separated to facilitate the filling of proximate cavities, tooth vibration due to preparing the cavity and applying gold produces an intense pain, relieved by inserting a wedge to distend and steady the teeth by constant and equable pressure. Individual susceptibility must be taken into account since the impressibility to pain and the power of endurance vary with race temperament and condition of the patient. After twenty-five the bones contain more earthy and less animal matter than during the formative and developmental period. The constructive stage having passed, the teeth are moved with more difficulty than in earlier life. With increased pressure needed to effect absorption, more pain and inflammation are produced. This is particularly the case when alveolar process hypertrophy is present. This pathologic condition is very common. The operator must be on the alert to discover its location at the outset of the operation, since unusual pressure is required to produce bone absorption. Cutting away the alveolar process is always indicated here. Strain upon the nervous system of the patient is thus greatly diminished.

Until a few years ago, lacunar absorption was supposed to be the only form of bone absorption. In a discussion of Interstitial Gingivitis, published in 1899, I demonstrated there were four forms of alveolar process absorption, lacunar or osteoclast, halisteresis, perforating canal and osteomalaciary (or senile) absorption.

The question had naturally arisen as to what gingivitis occur from movement of teeth? To determine this, experiments were made upon dogs. Impressions of the mouths were taken in modeling compound. Caps of German silver were then made for the cuspid teeth. A jackscrew was soldered to the caps with soft solder. The dog was then securely fastened into a V-shaped box, Fig. 260, with cotton bandages. When chloroformed the appliances were placed upon the teeth and cemented into place. A muzzle was then placed upon the head and the forefeet tied to prevent removal of the appliance. The muzzle and bandage were removed twice a day for the purpose of feeding. The screw was given one-fourth, one-half and one full turn every evening. The screws were 60 threads to the inch. The

teeth of three dogs were moved 1-240, 1-120, and 1-60 of an inch respectively per day, as suggested by Farrar.[1] At the end of three days the muzzle and leg bands could be removed,

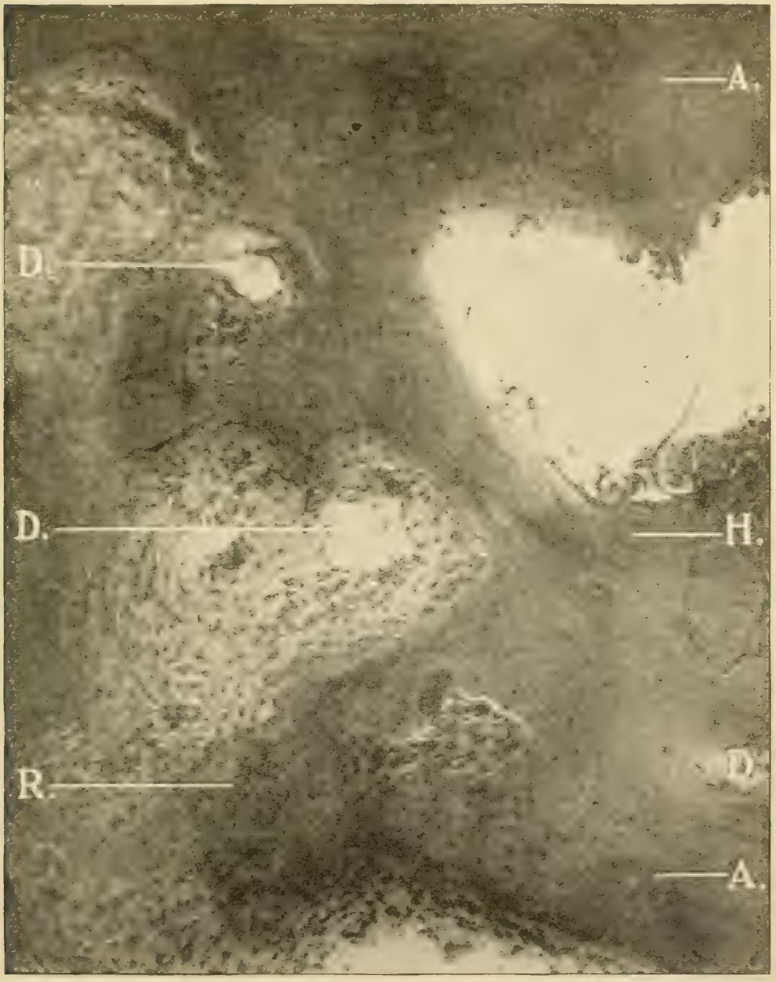


Fig. 264.
A. A. Zeiss obj. Magnification 173x. ¼ turn, 7 days.

the dogs having become accustomed to the appliances. This process (whereby the screw was turned one-fourth and one-

[1] Dental Cosmos, Vol. XVIII, page 23.

half turn per day) was continued for seven days. In those in which the screw was turned one full turn, it was continued for two weeks. The object was to set up pathologic changes in the alveolar process. The dogs were killed at the end of the periods mentioned. The jaws were placed in 65 per cent alcohol for twelve hours, then in absolute alcohol for forty-eight hours.

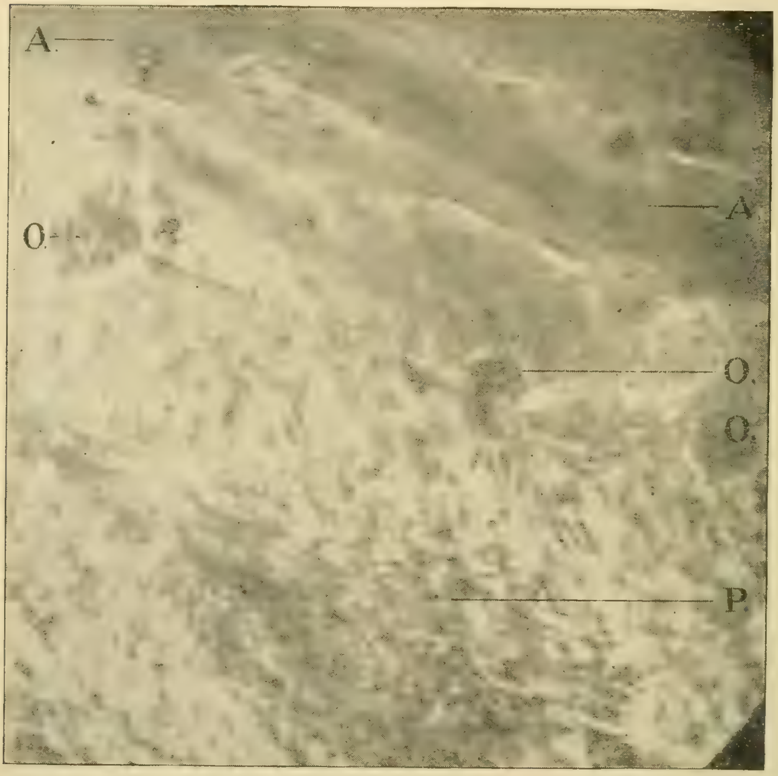


Fig. 265.
D. D. Zeiss obj. Ocular No. 2. Magnification 248.8x. ½ turn, 7 days.

They were then transferred to 5 per cent nitric acid and water. This was changed every two days for a week or until the tissues became so soft as to be easily penetrated by a pin. They were then placed in running water to remove acid. This took from twelve to twenty-four hours. The tissues were then placed in 65 per cent alcohol six hours; then in 95 per cent six hours,

and then in absolute alcohol twenty-four hours. The tissues were then imbedded in thin celloidin twenty-four hours, then in thick celloidin twenty-four hours. They were then mounted on blocks of wood and hardened in 80 per cent alcohol from six to twenty-four hours. The specimens were cut, stained in hæmatoxylin eosin.

The second illustration (Fig. 261) shows the normal alveolar process and its relation to the peridental membrane and adjoining teeth.

Third (Fig. 262) shows the condition of the alveolar process after the screw has been turned one-fourth turn for seven days. This is a longitudinal section of a cuspid tooth with the edge of the alveolar process in situ. A is the alveolar process; C the cementum of the tooth; H halisteresis; O osteoclast or lacunar absorption; P the periosteum.

The fourth (Fig. 263) is a cross section showing cuspid and lateral incisor with alveolar absorption between them. A alveolar process; B haversian canals; C cementum; E large medullary cavities arising from absorption of the trabeculæ; H halisteresis absorption; P peridental membrane; R round cell infiltration.

The fifth (Fig. 264), under high magnifying power, shows A alveolar process; D haversian canals with round cell inflammation about them; E large medullary cavities due to absorption of the trabeculæ; H decalcified bone or halisteresis; R round cell infiltration.

The next sections were taken from a dog in which the screw had been given one-half turn every day for seven days. Fig. 265 illustrates A alveolar process; O osteoclast or lacunar absorption; P peridental membrane with round cell inflammation. Fig. 266 shows A alveolar process; D haversian canals; H halisteresis; P peridental membrane. Fig. 267 illustrates A alveolar process; H halisteresis; O osteoclast absorption; P peridental membrane; R round cell inflammation; V vessels of von Ebner.

The sections following show absorption of the alveolar process from a dog in which the screw had been given a full turn or one-sixtieth of an inch every evening for fourteen days. Fig. 268 illustrates A alveolar process; B haversian canals; E large medullary cavities due to absorption of the trabeculæ; H halisteresis; VC Volkmann's perforating canals.

Fig. 269 under a higher magnification shows A alveolar process; D haversian canals; VC Volkmann's perforating canals. Fig. 270 (under a still higher magnification) shows A alveolar

Fig. 266.
A. A. Zeiss obj. Magnification 86.5x. ½ turn, 7 days.

process; H halisteresis; O osteoclast absorption; R round cell infiltration; VC Volkmann's perforating canal absorption.

If so many pathologic conditions occur in the alveolar process

from the movement of the teeth and in interstitial gingivitis, what may not be expected in tooth eruption and in healthy absorption of the alveolar process after teeth have been extracted?

In the following illustration (Fig. 271), taken from the jaw of a young monkey who died from burns, the inferior cuspid

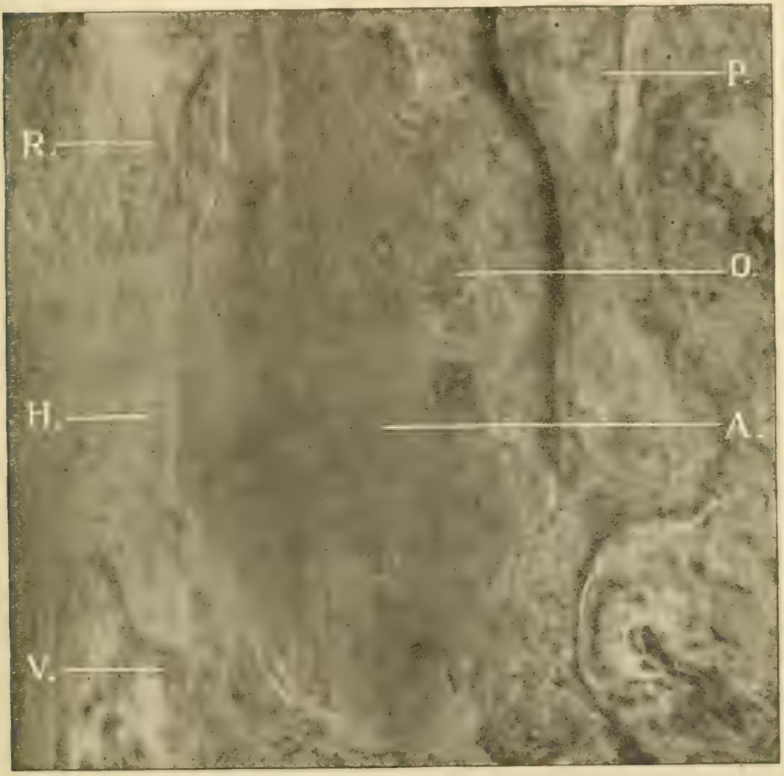


Fig. 267.
D. D. Zeiss obj. Ocular No. 2. Magnification 248.8x. ½ turn, 7 days.

teeth were pushing their way through the alveolar process, but had not presented themselves. The temporary cuspids were still in place. It shows A alveolar process; D Haversian canals; E large medullary cavities due to absorption of the trabeculæ; F fibrous tissue resultant on halisteresis.

In moving teeth of dogs the upper jaw alone was used. Some

teeth of the lower jaw were extracted to note the change in the alveolar process shown by the following illustrations. The teeth

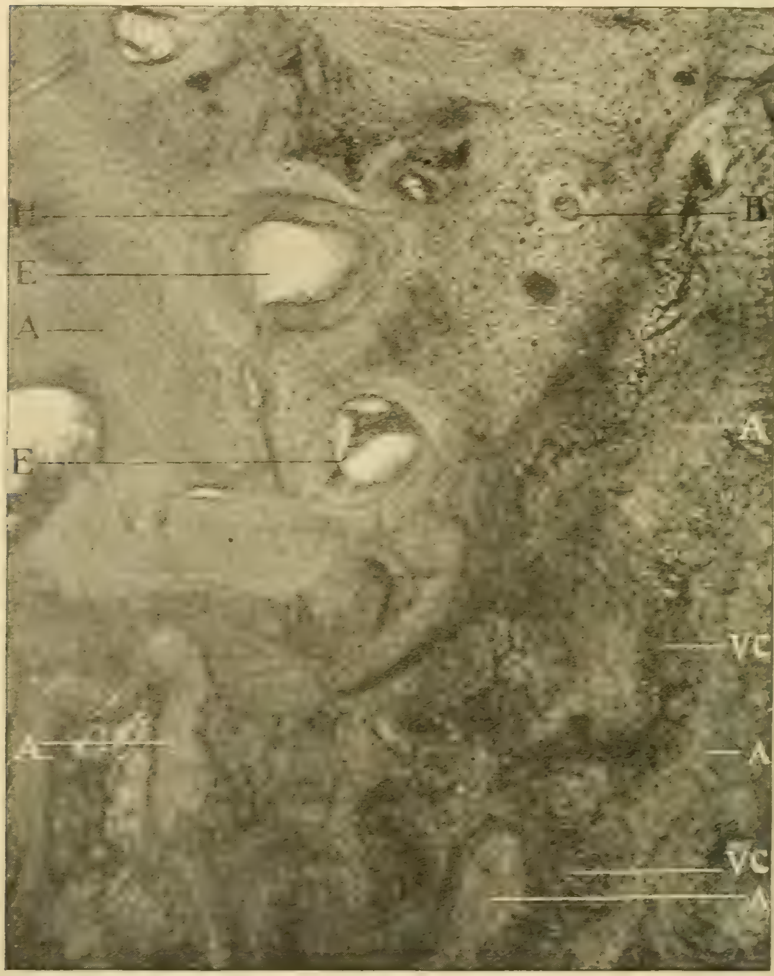


Fig. 268.
A. A. Zeiss obj. Magnification 86.5x. Full turn, 14 days.

had been extracted for seven days. Fig. 272, under low power, shows A alveolar process; D Haversian canals with round cell inflammation; O osteoclast absorption; VC Volkmann's perfor-

ating canal absorption. Fig. 273, under a higher magnification, shows A alveolar process; O osteoclast absorption; R round cell inflammation; VC Volkmann's perforating canal absorption.

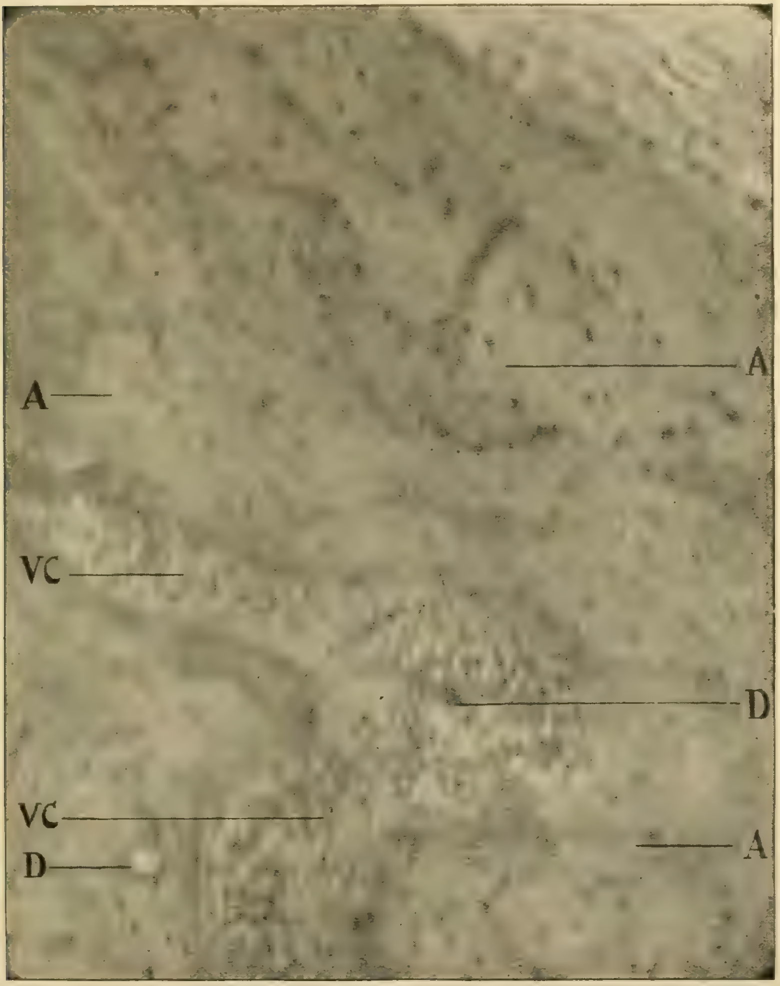


Fig. 269.
D. D. Zeiss obj. No. 2. Magnification 334.8x. Full turn, 14 days.

In Fig. 274 is seen A alveolar process; B Haversian canal; E large medullary cavity due to the absorption of the trabeculæ;

O osteoclast absorption; R round cell infiltration. In Fig. 275 is seen the absorption of the alveolar process. Interstitial gingivitis is observed due to auto-intoxication. In extracting the tooth, the detached bone was also removed with considerable fibrous tissue which was originally alveolar process. D dentine, C cementum, I inflamed fibrous tissue, J alveolar process, O osteoclast absorption.

It has always been supposed that normal absorption in the alveolar process under normal conditions was osteoclast or lacunar absorption and that if pressure were greater than the tissues could stand, inflammation set in and absorption ceased. Careful study of the process of absorption revealed that different results could hardly be expected in tooth movement. The surroundings of the alveolar process are the same. Absorption is the same, though the propelling forces be different; interstitial gingivitis irritation, the screw pressure, the eruption of the tooth and the extracted tooth. Were a tooth implanted into the alveolar process of a human being or a dog after full growth, the same methods of absorption illustrated will occur under these different conditions.

Absorption, as already stated, occurs as osteoclast or lacunar absorption, halisteresis, Volkmann's perforating canal absorption. As a normal senile function, osteomalacia or senile absorption produces destruction of the alveolar process and loss of the teeth. Waste and repair are so adjusted that upon the slightest irritation (even tooth extraction) osteoclast absorption, halisteresis and perforating canal absorption occurs. The influence of extraction on inflammatory conditions was carefully excluded by Dr. M. Herzog, who conducted the examinations, and his care is shown in the absence of inflammation in the peridental membrane. Pressure intensifies all forms of absorption. In the case in which the screw was given a full turn every day for fourteen days the teeth were found one-half inch apart. Absorption of the bony process was well marked. Halisteresis and perforating canal absorption was much intensified. When force is applied to the tooth the peridental membrane is compressed and the blood supply is cut off for the time being. The osteoclasts, because of the change in the blood current, are set to work. Absorption of alveolar process occurs not only adjacent

to the root of the tooth (as shown in Fig. 262), but also in the Haversian canals throughout the entire process (Fig. 263). Inter-

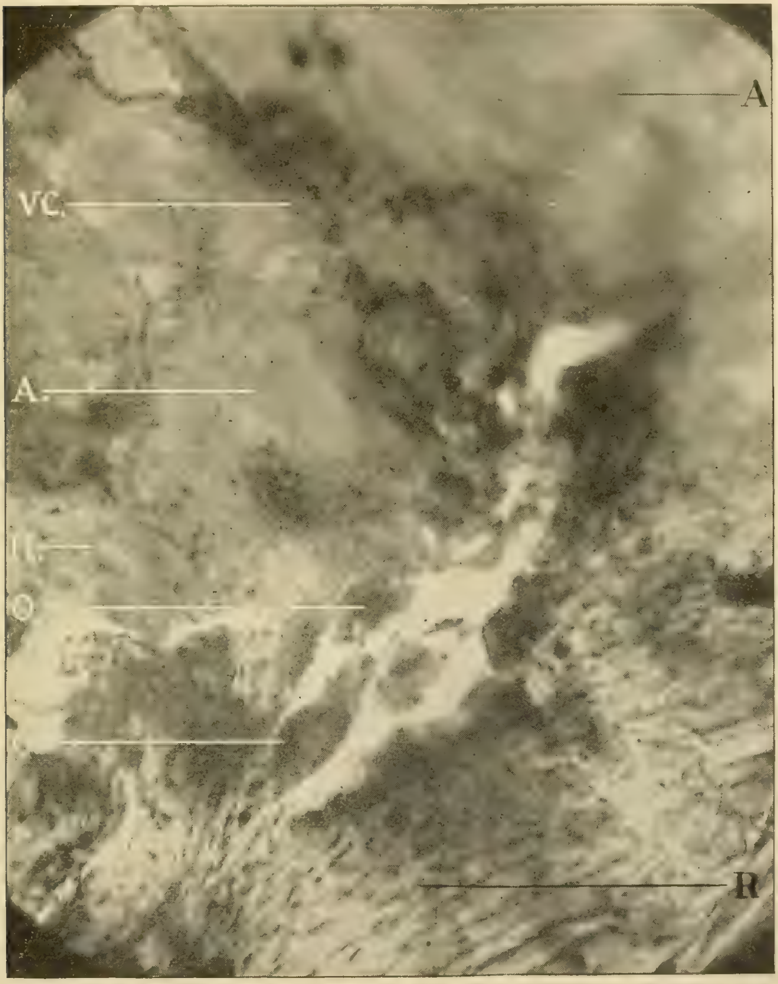


Fig. 270.
D. D. Zeiss obj. Ocular No. 2. Magnification 353.48x. Full turn, 14 days.

stitial inflammation is immediately set up in the arteries running through the Haversian canals, producing halisteresis. Through the walls of the blood-vessels round cell infiltration occurs into

the connective tissue. Remains of decalcified bone appear in Fig. 263. Frequently the irritation and inflammation has been

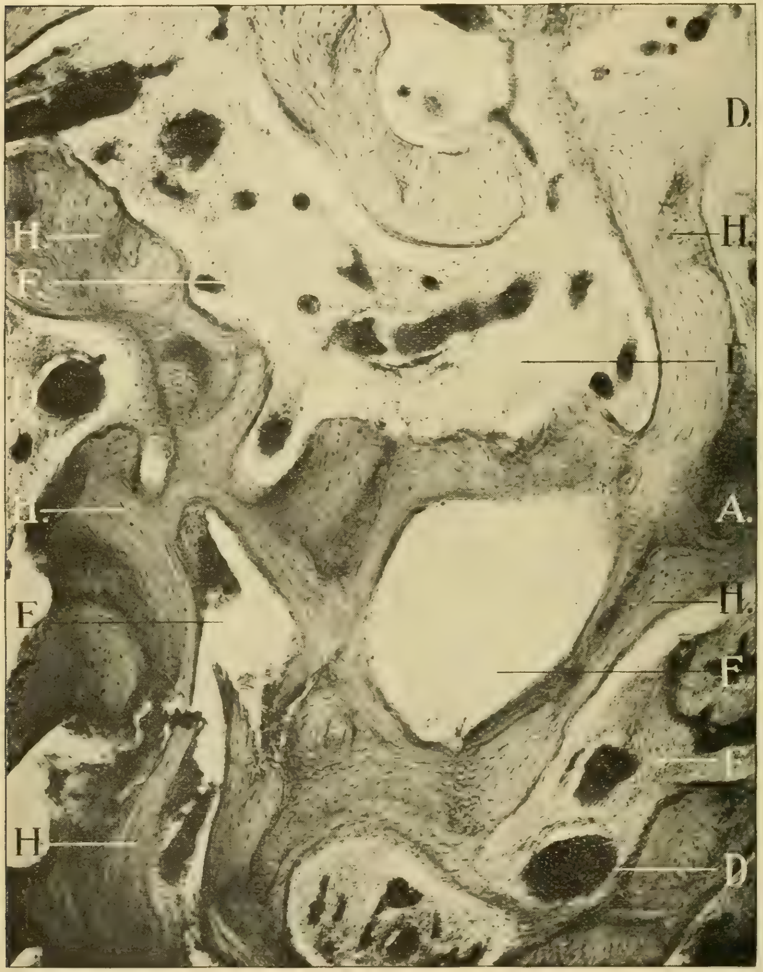


Fig. 271.
A. A. Zeiss obj. Magnification 86.5x.

so severe that the fibrous matrix is likewise destroyed (Fig. 264). The inflammatory process extends throughout the vessels of von Ebner (Figs. 267-8-9), producing Volkmann's perforating canal

absorption. The same types of absorption, as are observed in interstitial gingivitis occurred here under different conditions. Bone building is so much slower than absorption that two weeks did not suffice to show osteoclasts at work.

In cases of regulating late in life, retentive plates must often be worn, for two or three years, after the malposition of the teeth has been corrected until a bone deposition is sufficient to hold the teeth securely. The teeth most difficult to retain are those that have been rotated in the jaw, since these have a ten-

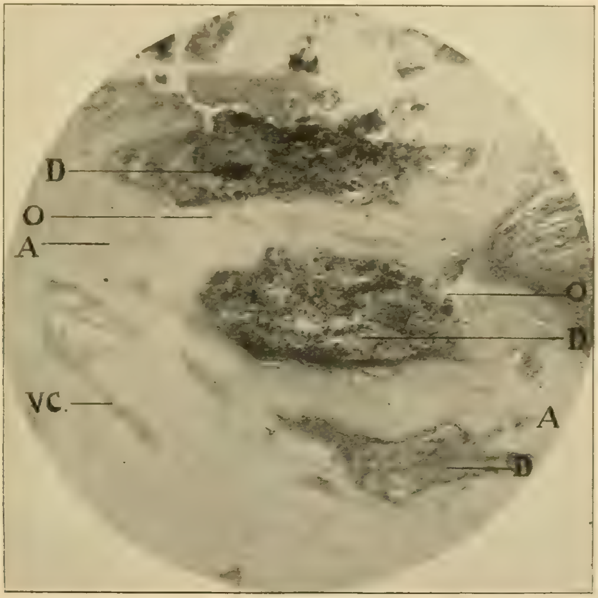


Fig. 272.
Leitz obj. No. 3. Ocular No. 3. Magnification 80x.

dency to return to their original, faulty position, through contraction of the fibrous tissue even after three years. By dispensing with the retentive plate for a day or two and then re-inserting it, any deviation in position can be readily noted.

When pressure is applied to a tooth, iritation extends through the fibrous tissue to the periphery of the bone structure. The osteoclasts begin to form in the fibrous tissue and extend into the bony tissue. Fig. 262 shows the fibrous tissue and

alveolar process. Only a small portion of the peridental membrane is seen. Absorption of the alveolar process has gone on to a considerable extent. Only a small portion of bone in the center being acted upon by the osteoclasts.

Fig. 263 shows the peridental membrane and the fibrous tissue extending through the alveolar process. The bone is entirely absorbed except a small portion in the center. Osteoclasts are seen at work producing absorption of the remaining structure.

In rotation of teeth, absorption of bone rarely takes place. Pressure of the peridental membrane causes the fibers to elongate and take the direction of the tooth. In making a reasonable pressure upon the teeth, the earthy substance of the bone is removed, leaving the fibrous tissue intact. The fibrous tissue of the bone retains the blood-vessels and osteoblasts. The pressure upon the tooth does not detach the peridental membrane. The application of force either in straight lines or rotation causes the fibers to stretch. Remove the pressure and the elasticity of the tissue will soon return the tooth to its original position; when the tooth or teeth have been forced to their new positions, fibrous tissue is developed to reinforce that which has been injured by stretching. Osteoblasts build up new bone tissue and in this way the tooth is held in its new position. To accomplish this, the tissues must be held perfectly still by retaining appliances upon the teeth. If the alveolar process has obtained its growth and the fibrous tissue (trabeculæ) is destroyed the chances of restoration are meager. In any case the normal contour will not be restored.

In the light of these experiments and the ease with which inflammation and absorption are produced, it is doubtful whether (as some claim) the alveolar process is ever bent into a new position. In any case should the process yield to pressure, absorption must continue until the pressure is relieved.

Not infrequently in children whose nervous systems are unstable, constant, steady pressure for any time will wholly unnerve the patient. It is not good practice to cause continuous pain for any length of time, by forcing the teeth through the alveolar process, when this can be accomplished by a much more rapid scientific method of cutting away the bone.

From what has been said of the alveolar process in its absorption and its terminal structure aspects, it is evident that the teeth cannot be corrected without pathologic disturbances.

While other forms of absorption must await the onset of inflammatory processes, osteomalacia or senile absorption sooner or later ensues in every individual. This from the unstable nature of the alveolar process is a normal absorption. This absorption is readily produced from slight irritation, like heat, auto-intoxication, drugs, etc. Osteomalacia normally occurs

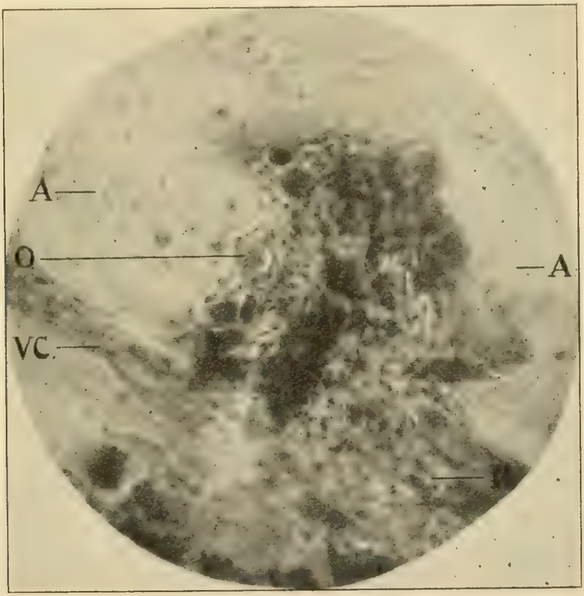


Fig. 273.
Spencer Proj. ¼ inch. Ocular 1 inch. Magnification 200x.

after the process has obtained its growth. It may, however, occur before that time when the pathologic factor is sufficient to overcome cell building; such as malnutrition, drugs, etc. The alveolar process is so unstable that interstitial gingivitis may be found in nearly every mouth, more especially in neurotics and degenerates.

Properly to correct irregularities requires a thorough understanding of the laws of degeneracy. When a practitioner prides

himself upon the rapidity with which he can correct irregularities, his methods demonstrate lack of knowledge of the structures upon which operations are done.

Extended force applied throughout the alveolar process will correct the ordinary deformity. If the force be so great as to destroy the trabeculæ, tissue building cannot restore the process. If great but not steady pressure be applied and if nutrition be poor, the alveolar process will not be restored.

Over three decades ago a dental professor regulated the

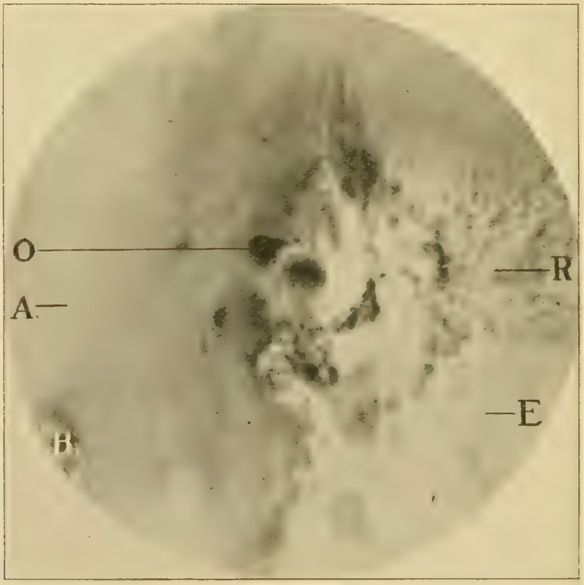


Fig. 274.
Spencer Proj. 1/4 inch. Ocular 1 inch. Magnification 200x.

teeth of a sixteen-year-old girl. This (in 1870) was considered a most successful operation. So pleased was the teacher that he invited the students to his office to examine the models and results. Four years after the girl married. She was under my observation till her death. The alveolar process was never restored. Interstitial gingivitis continued as long as she lived. The alveolar process absorbed from one-third to one-half the length of the roots upon all the teeth and they never became

solid in the jaw. They were always sore upon mastication. Occasionally pus infection occurred. By free use of iodin, interstitial gingivitis was much reduced as pus germs were thus destroyed. Although beautiful and with beautiful teeth, irregularity and alveolar absorption gave her an elderly appearance.

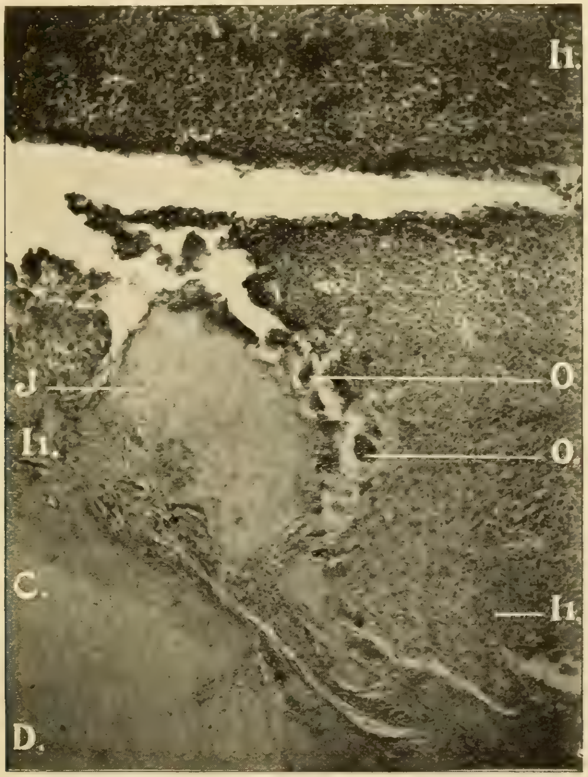


Fig. 275.

Malnutrition of the alveolar process should preclude an operation, or if it must be performed slow, steady pressure should be used to prevent excessive interstitial gingivitis. Patients with scrofulous, syphilitic or tubercular tendencies should be treated with great consideration. In such cases one or two teeth should be regulated at a time.

A twelve-year-old girl in delicate health had her teeth regu-

iated in 1891. The right superior central and lateral were rotated so that their palatine surfaces came together. The cuspids were separated and the teeth rotated into place. The lower cuspids were outside the arch. The arch was complete. The lower teeth did not show when the mouth was open. The cuspids were removed. At twenty-two health was much improved. Interstitial gingivitis from the regulation and extraction had never been diminished. An inflammatory process remained in circumscribed area the depth of the teeth.

The only question unsolved in regulating teeth late in life is whether the results are proportionate to the strain upon the system from the methods employed and from effects from the ultimate success.

The tendency in such cases is toward osteomalacia, although the other forms of absorption may occur. Permanent absorption may then ensue. Some years ago, a forty-five-year-old lady wished to have a right superior lateral incisor, which occluded inside the lower teeth, brought out into the arch with the other teeth. Powerful pressure was applied. The tooth was brought into place. Little absorption took place. The outer plate of the alveolar process was split, exposing the roots of the right central and cuspid teeth. The tooth was fastened securely and the bone united with considerable osteomalaciary absorption.

Extended operations should not be performed. If the case be successful and the teeth be retained in their position for the time being this is no evidence that the alveolar process will remain through life or that the next ten cases will be successful. The older the patient the greater the pressure required, the greater the amount of inflammation set up and the less chance of success. From the transitory nature of the jaws and the alveolar processes, density of bone in hypertrophy, the terminal structure and the ease with which inflammation and absorption ensue, the question naturally arises, when and how is regulation of teeth justified.

Cutting away of the alveolar process will always relieve excessive pressure, reduce the inflammation to a minimum and prevent extensive absorption. Correction of the teeth at all periods produces structural change in the alveolar process. The extent of this ever remains a predisposing factor to interstitial gingivitis.

CHAPTER XXXII.

SURGICAL CORRECTIONS.

Surgical correction of deformities of the jaws and teeth in its relation to dentistry resembles Orthopedic Surgery in its relation to medicine. Deformity correction implies mechanical operation upon the tissues in a way foreign to ordinary dentistry and hence special training is needed for its practice. The operator should be thoroughly endowed with mechanical ingenuity, familiar with mechanical movements as well as versed in pathology.

Some claim that fixed systems of appliances can be depended upon for the purpose of correcting a given line of cases, that these can be readily applied by the operator and the correction will proceed successfully and rapidly. This is but partially true. The dentist who advances such a doctrine is a victim of the one-sided bias which has done such harm to science.

The opening chapter of a recent work states that "it is often asserted, even by some authoritative writers upon the treatment of dental irregularities (Orthodontia), that no fixed system of appliances should or can be depended on: that each case so differs from all others as to require some new appliance peculiarly suited to that case, and that only. * * * The author believes and has proven, that it is not only possible, but practicable to systematize, classify and provide ready-made regulating appliances reducing them to few simple forms, to meet by their combinations the requirements in all varieties of cases susceptible to treatment." Centuries of experience in surgery have demonstrated that appliances must be adapted to the case and not the case to the appliance. This is particularly true of dentistry where results must depend upon the educated touch rather than the appliance. The orthopedist would scoff at the idea of having routine appliances always on hand for correcting all deformities. Certain parts may be kept on hand for certain fixed forms, but even these must be adjusted to the special case.

That the same law exists as to appliances for correcting deformities of jaws and teeth needs no demonstration.

The victim of such teachings frequently fails in his cases by relying too much upon a "system" rather than upon general principles. One kind of appliance may be used to start the operation, but the skilled, unbiased operator will observe that a different appliance can be used to a better advantage; especially in connection with one already in use. The victim of a "system" cannot be a skilled operator because of mental limitations thereon resultant. "Our little systems have their day. They have their day and cease to be."

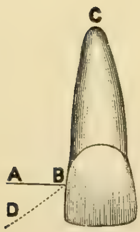


Fig. 276.

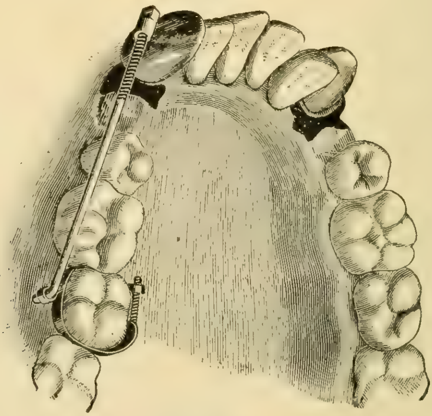


Fig. 277.

The constitution and health of the patient must always be considered. An appliance theoretically adapted to a given case may be wholly unfit because of the patient's physical condition. An appliance suitable to one period of life will not be to another.

In order to work in the shortest time and with least inconvenience, knowledge of the mechanical forces, the powers and limitations of each, and method of application are needed. All forces act either continuously like the lever, or interruptedly like the screw, but in either case their action diminishes with the yielding of the tooth. The mechanical powers are all modifications of two primary principles; the inclined plane and the lever. From these other forces are derived, thus:

The Screw,	The Inclined Plane,
The Lever,	The Wedge,
The Pulley, Wheel and Axle,	Elasticity.

Elasticity plays an important part in the application of force

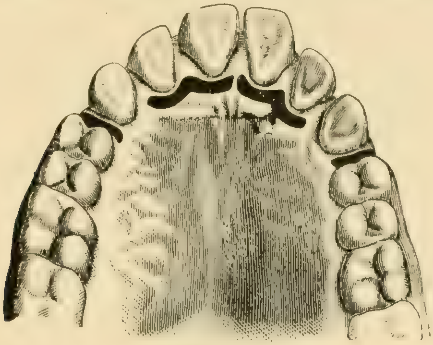


Fig. 278.

in regulating teeth. All of these forces have their places in the correction of deformities of the jaws and teeth. Appliances cannot be made which do not include one or more of these forces. All the forces may be successfully used in regulating teeth.

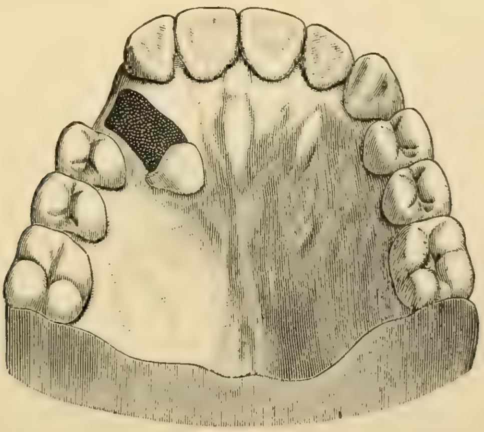


Fig. 279.

Principles, rather than systems, should be taught in our schools. Each may be used to a good advantage in given cases when judgment has been employed in selection and adjustment of appliances and in adopting the methods of using them. With

these laws and their applications firmly fixed in mind, the operator can select the one which should properly be applied, or, if more than one is needed, can so combine them as to accomplish the desired result. The degree and line of force required have much to do with the form of appliances needed.

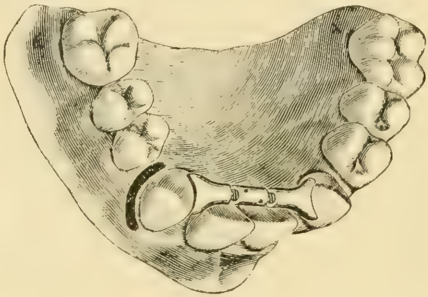


Fig. 280.

Every appliance for regulating the teeth aims at the object to exert pressure upon the teeth to be moved. An appliance for this purpose should be as small as compatible with effectiveness and strength. It should be so constructed it can be applied inside of the arch in such a manner it will not interfere with

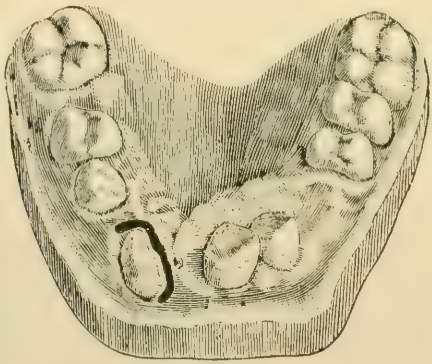


Fig. 281.

speech or mastication and can be removed for cleansing. It should give as little annoyance as possible and should not necessitate frequent visits to the dentist for adjustment. Whether the teeth are to be forced out or drawn in, there is always to be considered a body to be moved (the tooth) and a fixed point of resistance.

Study of the model does not always determine the amount of force required to move the tooth. The model should be studied but not to neglect care. While usually a point opposite can be chosen for the anchorage of the appliance, this does not always hold good. Every case is a problem in itself. The point of anchorage must, of course, afford greater resistance than the

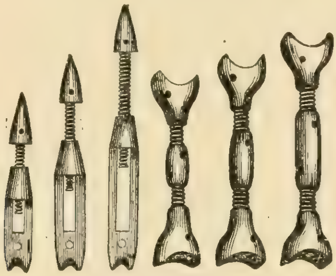


Fig. 282.

point to be moved. To find such a point is sometimes difficult. Such is the case where a cuspid has to be moved. In such cases it frequently happens the dentist finds, to his chagrin, he has moved his point of resistance rather than the tooth. Constant vigilance must, hence, be exercised in noting occlusion. The

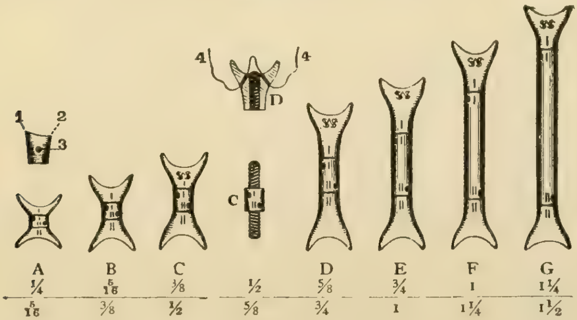


Fig. 283.

patient should be asked, at each sitting, in which tooth he suffers most when the nut is turned. It is often found expedient in moving teeth that afford great resistance, like central incisors or cuspids, to loosen them first by simple wedging with orange wood, or even cotton, proceeding slowly. This causes slight inflammation, then absorption of the alveolar process around

the tooth or teeth to be moved, giving these teeth a decided advantage when force is applied. Thus resistance is lessened and the tooth or teeth to which the appliances are attached will now afford greater resistance in proportion that at first.

Sometimes a plate can be constructed to which an appliance for moving a tooth may be attached. This is desirable (1) where there is not a tooth conveniently located for attachment; (2) when it is expedient to avoid the additional irritation; (3) when the mechanism is such as to require it. In applying the apparatus to a tooth, its position in the jaw should be observed and the inclination of the root or roots must be ascertained to decide whether they stand perpendicularly in the alveolar process or on an incline. All obstructions should be removed by extraction or by lateral pressure.

The force should be applied to the tooth to be moved either

Fig. 284.

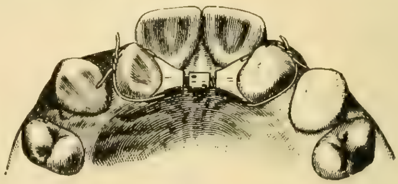


Fig. 285.

at right angles to the long axis of the root (Fig. 276, a, b, c), or at an angle of 45 degrees, d, b, c. By these means the tooth is prevented from rising from the socket. The position of the tooth in the jaw, the density of the alveolar process, the length of the roots, their normal or abnormal condition and length of crowns, all require consideration in deciding amount and direction of force to be used without elongating the tooth. Drilling of holes in natural teeth for anchorage is practiced by some reputable dentists. There are, however, few cases that cannot be treated by securing a band or cap of thin gold or platinum to the teeth with zinc oxyphosphate, in which band holes may be drilled or hooks or loops soldered at any required point.

If the superior maxillary bone be examined after the teeth are removed, the outer plate of the alveolar process is found much thinner than the inner, which is backed up by the strong, thick bone of the hard palate. Upon the inferior maxilla the

outer plate of bone is thinner as far back as the second bicuspids and the inner plate is thinner at the parts occupied by the molars. The inner plate is thickest between the second bicuspids upon either side and is reinforced by the symphysis and gential tubercles. The external plate is thickest in spaces occupied by the molars and is backed by the external oblique ridge. When the soft tissues have been removed from the superior maxilla, it is not uncommon to find the roots of sound, healthy teeth extending through the outer plate of bone. After the teeth have been extracted, absorption of the outer plate takes place

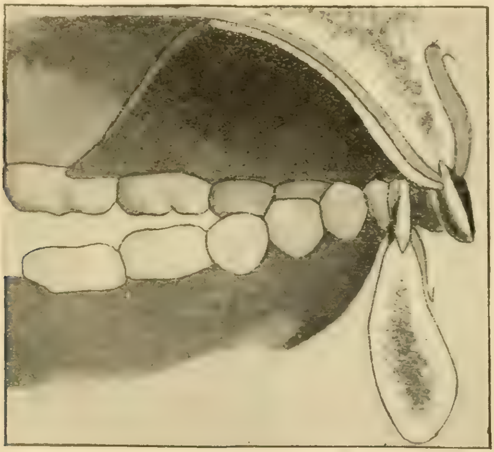


Fig. 286.

much more rapidly than of the inner plate. Absorption of the external and internal plates of the inferior maxilla goes on more uniformly than in those of the superior, owing to a more even distribution of bone. In all cases, the thick or hypertrophied alveolar process should be cut away, as illustrated elsewhere.

In the application of force, most pressure is required in the direction of the greatest resistance. Care must be exercised in directing the force toward the weaker parts of the alveolar process.

If possible the force should be uniform and steady, but this while possible with certain appliances like the elastic band, liga-

tures and the like, is impossible with the screw. All forces act either slowly and constantly like the above, diminishing in their action in proportion to the yielding of the tooth, or else they act by impulse like the screw.

The force exerted should be enough to produce absorption of bone with slight inflammation. Too rapid movement of the teeth, especially when patients are over twenty years of age, should not be countenanced. The alveolar process may be absorbed to such an extent that it is impossible to retain the teeth in their proper places, as new material is not deposited. The extensive inflammation resulting from the excessive force required prevents restoration of bone.

The inconvenience and unsightly appearance of many appli-

Fig. 287.

ances required, when great pressure is needed to move certain teeth (notably cuspids, upper and lower), either forward or back, is another objection. Appliances adjusted to the head are so unsightly and embarrassing that not infrequently the patient is deterred from the operation, which would otherwise have been undertaken could some method be adopted which would not detract from personal appearance.

The results of attachment of appliances to the molars for the purpose of moving the cuspids and incisors back frequently chagrins and mortifies the operator when he discovers that, instead of the molars being the fixed point and the cuspids drawn back, the reverse has occurred.

One most difficult problem to solve, which always requires

extra pressure, is that when the inferior alveolar process has become excessively developed, carrying the incisors upward until the cutting-edges come in contact with the mucous membrane in the vault of the mouth, which causes proliferation of osteoblasts that carries superior incisors forward (Fig. 12).

Density of bone often makes it difficult to obtain sufficient force to produce the absorption of this tissue required to bring the teeth back into place. Probably one of the most difficult operations is to carry a cuspid, which is erupting in the vault of the mouth, back into its normal position. This not only requires considerable force, but time, to say nothing of the difficulty in attaching a cap for a point of resistance. Rotation

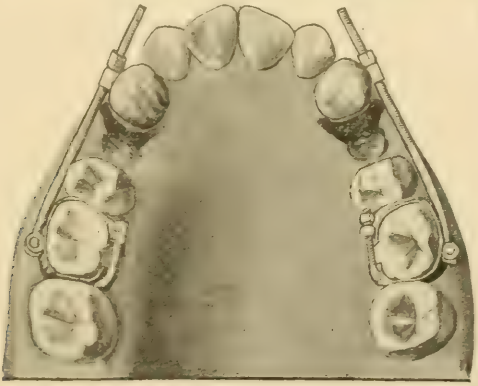


Fig. 288.

of the teeth, especially the incisors and cuspids, is frequently difficult, if not impossible, owing to insufficient leverage.

Many other situations present themselves to the operator in his practice other than those mentioned, but as all require treatment in the same manner, only the most difficult cases have been considered. After an appliance has been adjusted, no matter of what nature and pressure applied, the long, tedious method of plowing through the alveolar process (regardless of the density of the bone) by absorption is pernicious and unscientific, not to speak of the long, tedious days, weeks and months of suffering. The period of life most acceptable for the correction of these deformities is between twelve and sixteen years.

This time is to the patient the most critical and as in every case they are degenerates with an unstable nervous system, the greatest care should be taken not to subject them to great strain. Nervous prostration of years' standing may result, and patients be permanently injured by such nerve-strain.

To obviate excessive pressure as well as unsightly appliances I have for many years proceeded in the following manner, based upon modern principles of surgery: This method consists in removing the alveolar process in the line of travel of the tooth to be moved, leaving a small amount of process about the root of the tooth, holding intact the peridental membrane. This

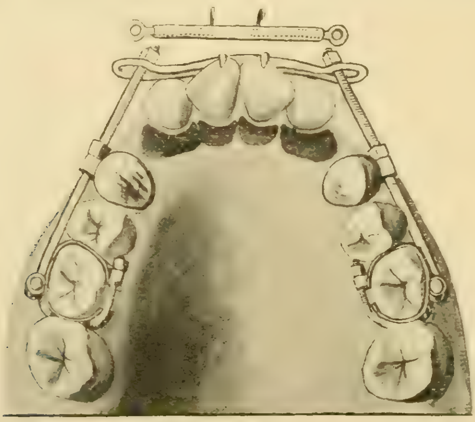


Fig. 280.

is accomplished with coarse-cut Revelation burs, or those that will cut in all directions. They can be used as drills in certain conditions, to be mentioned later on.

If the cuspids require to be carried backward, make an appliance with bands about the first and second molars, with caps upon the cuspids and a bar with a screw nut upon the end, as recommended by Dr. Farrar. Extract the first bicuspid and adjust the appliance. Then, resting the hand against the cuspid, cut out the lingual and buccal V-shaped plate, making a concave surface of the alveolar process, as illustrated in Fig. 277.

If the superior incisors are to be carried back, cut semicircular spaces just posterior to the teeth to be moved (Fig. 278). To carry a cuspid into place which is erupting into the vault of

the mouth, remove the alveolar process in the direction of the line of travel (Fig. 279).

In moving teeth laterally by a jack-screw, it will be found that not infrequently one tooth moves faster than the other. To bring both to their proper position, cut out the alveolar process on the side of the slowest-moving tooth and both will come into proper position (Fig. 280). To rotate a tooth, cut a circular groove as deep as possible around the tooth, leaving enough process to hold the peridental membrane intact (Fig. 281). In this manner teeth may be moved very rapidly and without much pain. This should always be done by means of screws. By this method the tooth or teeth to be moved are

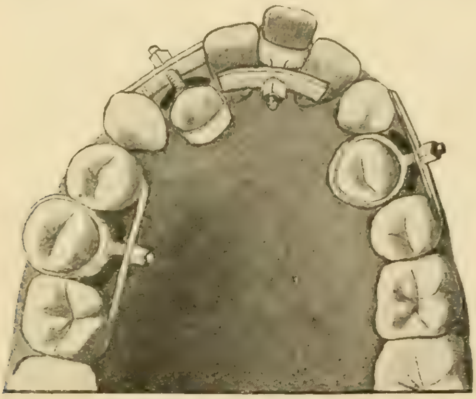


Fig. 290.

completely under control. Any of the teeth in the mouth may be used for fixed points of resistance, thus doing away with all unsightly appliances outside the mouth. When in place, they should be anchored in the usual manner. Antiseptic washes should be used from time to time.

Appliances of different forces should be discussed in order of their value as adjuncts in the correction of irregularities of the teeth. Long and skilled experience has shown the screw to be the most valued instrument for this purpose. When the appliance is once adjusted upon the teeth, the procedure is positive and simple, causing less pain and producing more uniform results. It is a modification of the inclined plane and always

requires a lever for the purpose of turning it. It may be used for penetrating wood, like a thumb-screw, a gimlet, etc., or it may be used as a moving force, as in raising buildings, or in the familiar letter press. In these cases, it must work in a hollow cylinder with a corresponding thread cut inside which is called the female screw, or nut. When the screw is turned in the nut, it will either advance or recede. With the screw, the power produces a pressure as many times greater than itself as its circumference is greater than the distance between the threads.

It should be noticed that, unlike other mechanical powers described, the screw works by impulse, each turn producing an effect at once when the motion is ended. This kind of force is of peculiar importance to the dentist since it is positive and when properly applied can always be depended upon. It is a

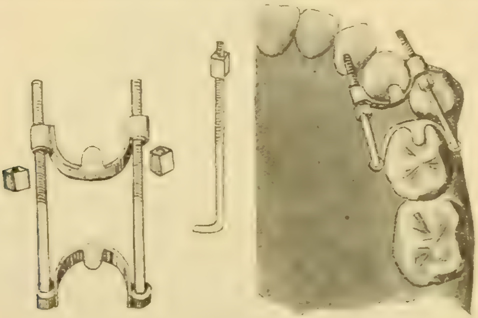


Fig. 291.

powerful agent in widening the dental arch; obstinate cases yielding readily to the pressure. Dr. Farrar, after years of careful experience with different appliances for regulating teeth, more than three decades ago[1] set forth strong reasons for using the screw. The results of his experiments on tissues first with elastic and afterward with the screw were decidedly in favor of the latter.

He uses the screw having sixty threads to the inch. The screw is turned one-half a revolution morning and evening, thus advancing the nut one-half of a thread or 1-120 of an inch at each operation, or 1-60 of an inch per day. This rate was found to produce no pain; a repetition of the sense of tightness was noticed for about one hour after every advance of the screw, but

[1] Dental Cosmos, Vol. XVIII, page 13.

it easily was borne by the patient and produced no perceptible pain.

His method and experience are of so much importance that his conclusions deserve quotation and emphasis. "First, That in regulating teeth, the traction must be intermittent and must not exceed certain fixed limits.

Second. That while the system of moving teeth by elastic rubber apparatus is unscientific, leads to pain and inflammation, and is dangerous to the future usefulness of the teeth operated upon, a properly constructed metallic apparatus, operated upon

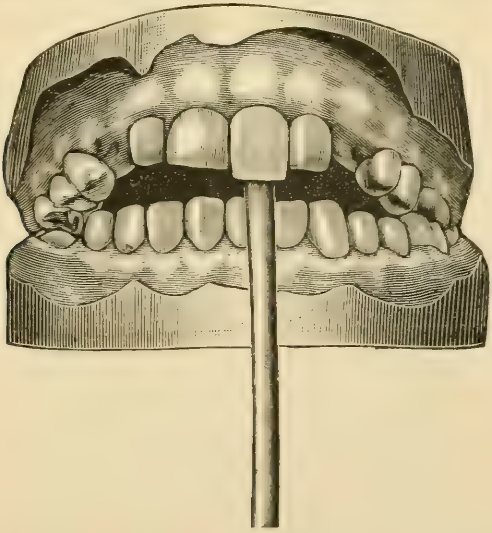


Fig. 292.

by screws and nuts, produces happy results without pain or nervous exhaustion.

Third. That if the teeth are moved through the gums and alveolar process about 1-240 of an inch every morning, and the same every evening, no pain or nervous exhaustion follows.

Fourth. That while these tissues will follow an advancement of a tooth at this rate (1-240 of an inch) twice in twenty-four hours, the changes being physiologic, yet, if a much greater pressure be made, the tissue changes will become pathologic.[2]"

[2] In the chapter on physiologic and pathologic changes the experiments show that the movement of the teeth is always pathologic.

To Dr. Wm. H. Dwinell, of New York, the profession owes a debt for the introduction of the jack-screw as a powerful, direct force in regulating teeth. The following cuts (Fig. 282, Nos. 1, 2, 3) are the original jack-screws introduced by Dr. Dwinell, and are very efficient when combined with rubber plates. The

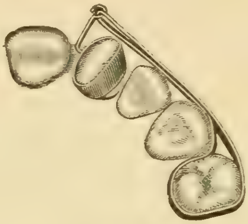


Fig. 293.

screw is just what is termed in mechanics a right hand thread with a single nut. The distal end of the screw is made conical that it may be directed either in the plate or band around the tooth to be moved. Nos. 4, 5, 6 show Dr. A. McCullom's invention, and are called compound jack-screws. They are made with

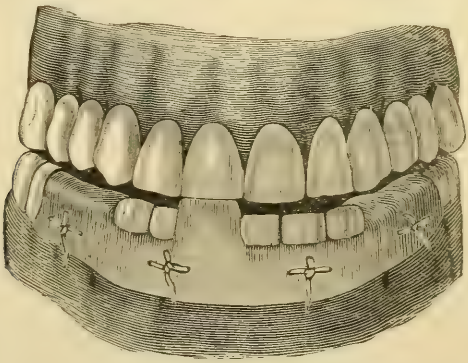


Fig. 294.

right and left thread, with nuts to correspond, so that when adjusted they will expand or contract if a lever be inserted in the holes drilled through the center of the bar and moved in either direction. The length of the bar may differ according to the convenience of the operator.

Some years of practice showed, however, these screws were

not only rather bungling as to size, but that the threads were too coarse. Frequently shorter screws could also be used to an advantage. For some years, I made my own screws. Later, at my suggestion, they were made by the S. S. White Dental Manufacturing Company (Fig. 283). They are a modification of the

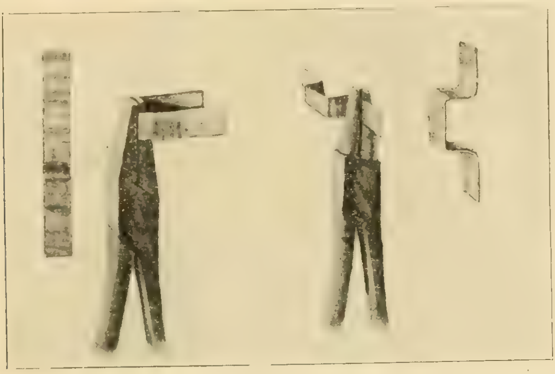


Fig. 295.

Dwinell-McCullom set, and in every respect have decided advantages, one of the special features being that the nuts are hollowed out at the ends, thus readily adapting themselves to the crowns of the teeth and preventing their slipping. These screws are admirably adapted for the purpose of widening or enlarging the dental arches. This may be done by banding two

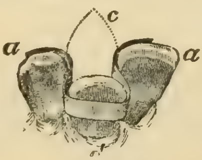


Fig. 296.

or more teeth upon either side, lengthwise to the dental arch and attaching the screw in a position which will give uniform pressure. The location will depend upon the shape of the dental arch and the location of the teeth. Another method I frequently adopt is to make a rubber plate, similar to that of Kingsley's,[3] vulcanize it only sufficiently to make it springy and locate

[3] Oral Deformities, Fig. 46.

the modern jack-screw at the narrowest point or where the most pressure is required. The difficulty, however, in using plates is that after the teeth have been pushed beyond the perpendicular line, the plate is with difficulty kept in the mouth. I overcome this difficulty by cementing bands with lugs upon them to the teeth. By so doing the plate cannot slip out of the mouth. Two teeth, one on either side, may be carried laterally uniformly. If one is progressing faster than the others the alveolar process about the one which moves the slowest may be cut away. In this way uniformity of distance can be obtained.

The screw should always be used in combination with a plate or with bands; otherwise the alveolar process and gums may be

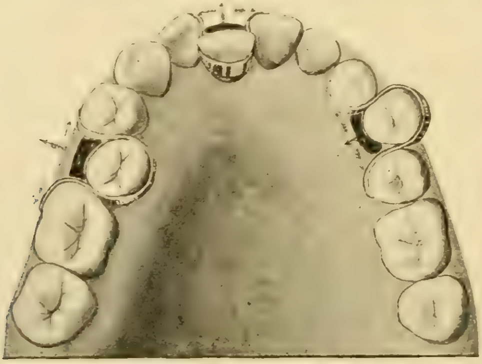


Fig. 297.

injured. When the bicuspids and molars stand inside of the arch, and a uniform pressure is required on both sides of the arch, the nut is prevented from working into the gum by placing around the teeth to be moved platinum bands with projectives soldered to the edge nearest their cervical margins (Fig. 284).

If the deformity be only on one side of the arch, it will be necessary to obtain either a fixed point opposite, by uniting three or four teeth with bands, and thus giving a strong support, or by inserting a rubber plate. When the plate is finished, a groove may be cut or a hole drilled to hold the screw in place. The screw may be called a universal force, as it can be made to force teeth in or out, or in any direction, provided a fixed

point can be obtained from which to work the screw. Where the roots are in a diagonal position in the jaw, or are in close proximity to other roots, the screw is very effective. As already shown, holes should never be drilled in sound teeth.

The shorter jack-screws are very efficient when a tooth is out

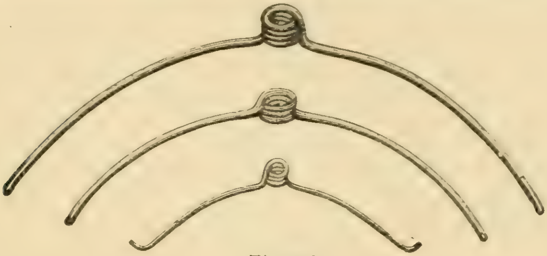


Fig. 298.

of line and it is possible to obtain sufficient space by forcing a number of teeth in opposite directions, especially where great force is required, as illustrated in Fig. 285.

One of the most common and most difficult forms of deformities which require treatment and considerable thought need not now be described in detail, since its many complications can be reduced to simple forms. The pathology of this is elsewhere

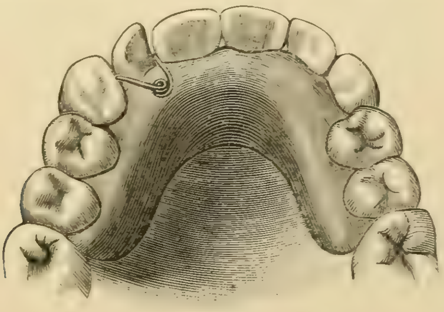


Fig. 299.

discussed. There are many other deformities of the teeth in which various portions of these appliances may be used with success. Judgment and skill of the operator is here an absolute necessity.

A rubber plate (Fig. 286) is placed in the mouth, fitting the vault and of sufficient thickness in front to separate the posterior

teeth, in order to lengthen them and to force the lower incisors (which alone rest upon the plate) into the jaw. This was renewed once or twice to give additional space (Fig. 287). When this process is completed, which requires from three to nine months, it leaves a space of three-sixteenths of an inch between the vault and the lower incisors when the jaws are closed.

After the models are obtained and before extraction of teeth, the operator should make anchor clamps or bands and adjust them to the first or second molars, or both. Caps should then be made to cover the cuspids, which are to fit loosely and to extend up to the gum margin all around. This is necessary because of the cone-shaped crowns and the great force required

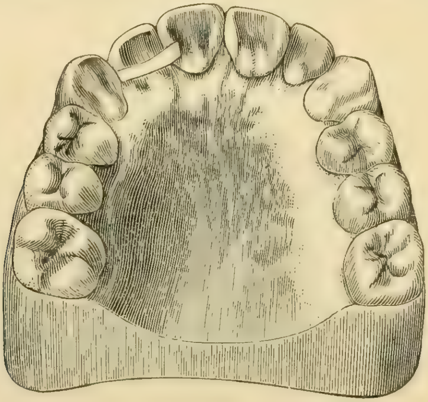


Fig. 200.

to move the tooth, the caps are liable to be pulled off. Tubes should then be soldered upon the caps and bands to accommodate the screws and nuts.

Pending the making of appliances, wedges of wood or rubber should be placed between the second bicuspids and molars and first and second molars to make room for the bands. When all is ready, the first bicuspids should be removed and the appliance fastened into place. After the teeth have been thoroughly cleaned with alcohol, the caps and the bands should be cemented and the bands cemented or fastened by the screws. The nuts should be turned against the caps about six hours after the bands are cemented. Twenty-four hours should elapse before pressure is placed upon the tooth to allow the cement to become perfectly

hard. With a good, sharp, coarse bur, previously rendered aseptic, cut out the V-shaped alveolar process on buccal and lingual surfaces (Fig. 288), up as far as the bicuspid cavity extends. This will relieve the operator of anxiety as to forward movement of the molars, the fixed point, and will not require the patient to wear a head cap. It will at the same time accomplish the work in less than half the time without strain upon the patient. When the cuspids have been carried back as far as required, the appliance will answer the purpose of holding them in position until the rest of the operation is completed. A bar should then be fitted to the incisors with hooks extending over the centrals to prevent the bar from slipping upward. Owing to the diverging screws, the bars may be made with long slots or the central piece may be

Fig. 301.

a tube with loose ends (Fig. 289). The alveolar process should then be cut away and force applied. As the teeth move backward the ends of the bar lengthens. When all is completed, the appliance is removed and a wire soldered to bands which have been so adjusted to molars or second bicuspids to hold all in position.

The cuspids on the lower jaw sometimes erupt forward, causing contraction of the jaw and irregularities of the incisors. From the dense bone in that locality, this is one of the most difficult conditions to correct. Proceeding in the manner described in the previous case, the operation becomes at once simple and easy (Fig. 277).

The application of the screw for moving the various teeth in or out into the dental arch by a surgical process is illustrated in Fig. 290.

A method employed to obtain space in the dental arch and which in many cases is admirably adapted for the purpose, is illustrated in Fig. 291.

The lever "is an inflexible bar, capable of being moved about a fixed point, called the fulcrum." The resistance is the object to be moved; the fulcrum is the fixed point of support; the power is in the force which overcomes the resistance. According to the relative position of these are three kinds of levers:[4]

1. Lever of the first kind: Power—Fulcrum—Resistance.

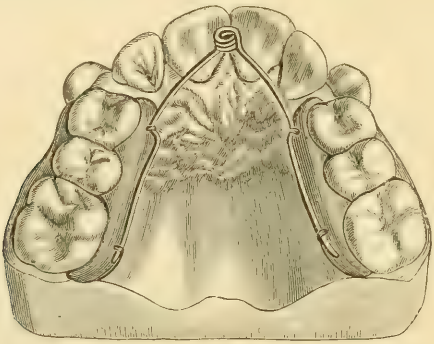


Fig. 302.

2. Lever of the second kind: Power—Resistance—Fulcrum.

3. Lever of the third kind: Resistance—Power—Fulcrum.

An example of the first kind is the crow-bar; of the second, the wheelbarrow; of the third, the forceps.

Intensity of force is gained and time is lost in proportion as the distance between the power and the fulcrum exceeds the distance between the resistance and the fulcrum.

In using the lever for the correction of irregularities it undergoes modifications. Thus, when it is applied in the form of a ligature or an elastic band, it becomes flexible instead of rigid, the fulcrum frequently becomes a surface instead of a mere point and the power is changed into resistance.

[4] These can be remembered by the formula, 1 2 3, F R P. In the first, the fulcrum is in the middle, the second resistance, the third power.

Where the leverage can be multiplied most stubborn cases succumb, as is illustrated in rotating teeth set very firmly in the jaw, or those crowded closely, or teeth of persons in advanced years, where the alveolar process has become very dense and

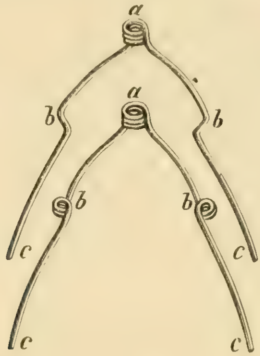


Fig. 303.

hard. The increase of power in the lever is obtained by lengthening the rod proportionately or in combining the leverage with another force.

The application of an increased length of rod is limited, for

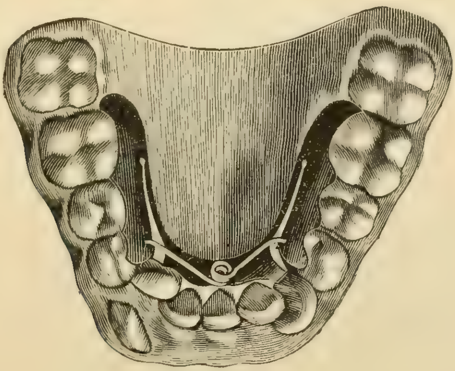


Fig. 304.

want of space in the mouth; for in above rather limited dimensions it interferes with the tongue or lips. The lever is required in wherever the anterior superior teeth occlude inside of the inferior teeth, if the case appear early enough. It is always desirable to regulate these teeth as soon after their eruption as

possible, i. e., before the bony tissue becomes dense and hard (Fig. 292).

This is a lever of the first kind. The upper incisor that strikes inside is the resistance to be moved, the lower incisor against which the stick rests is the fulcrum and the hand holding the stick is the power. The greater the distance between the hand

Fig. 305.

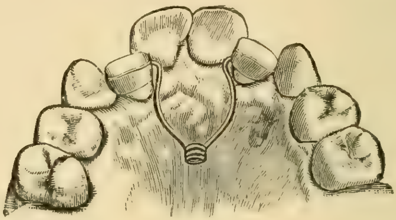


Fig. 306.

and the resting place of the stick, the greater the force exerted. When such cases are to be treated, the patient comes to the office at 9 A. M., and sits in front of the operating chair where the operator can watch what is going on. A long, flat file handle or similar instrument is placed in the mouth, as illustrated. The patient holds the instrument firmly against the teeth. A day and sometimes half a day is sufficient to bring the tooth outside of

Fig. 307.

Fig. 308.

the lower teeth. As soon as the upper tooth strikes outside the lower the operation is completed on the principle of the wedge. Every time the patient closes the teeth with any degree of force, the wedge (the lower incisors) is driven a little farther under the upper, thus forcing it outward until even with the rest. This appliance is of little use after the patient has arrived at the age of twelve or fourteen. The lever is more successfully used in

connection with bands and tubes for rotating teeth as observed under the heading, "The Pulley, Wheel and Axle."

The simplest form of leverage is a wedge of cotton, gutta percha or wood. The yielding tooth becomes the resistance, the

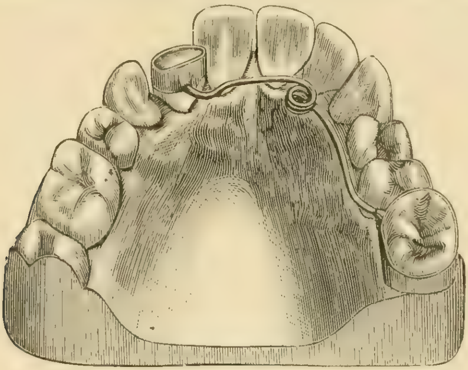


Fig. 309.

resisting tooth the fulcrum, and the elasticity of the intervening wedge the power. When cotton or wood are used capillary attraction becomes the source of power, inasmuch as it results in the absorption of moisture.

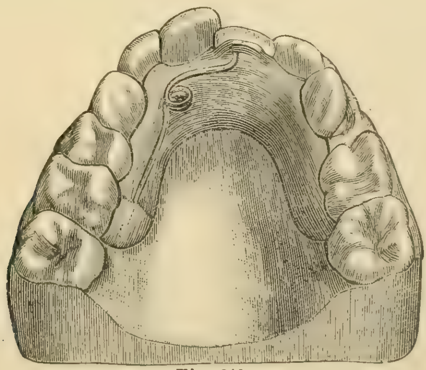


Fig. 310.

Leverage depends for its efficiency on the point where it is applied. Judgment and thought exercised in this will amply repay in the time gained and pain saved. In case the tooth is to be brought in, it is a matter of some consequence whether force is applied half-way betwen the cutting-edge and the neck or at

the cutting-edge. The apex of the root always being the fulcrum, the farther from this it can be applied, the better; hence, it is desirable to apply it as near as possible to the cutting-edge. A tooth with a long root furnishes the advantage of distance from the fulcrum, which is, however, more than counterbalanced by the additional resistance thus offered, as it is easier to move a tooth with a short root.

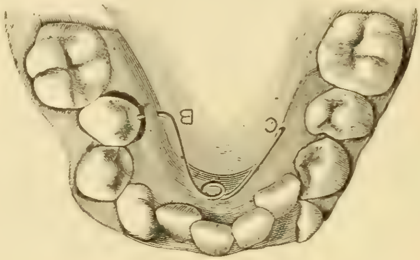


Fig. 311.

The pulley is a wheel with a groove cut into its circumference, and is movable upon its axis. In mechanics the common term for pulley is sheave. The pulley or sheave is placed between the oblong blocks of wood through which the axis passes and supports the pulley in the center. The cord passing around the pulley is called the tackle. The bucket and weight in the old-fashioned well illustrate the pulley. The wheel and axle is a modification of the pulley. The wheel is fastened securely to the

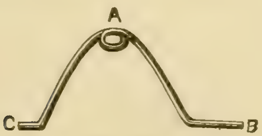


Fig. 312.

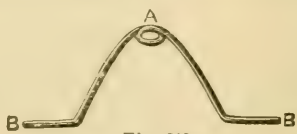


Fig. 313.

axle; the weight is attached by a rope to the axle, and the power by a rope to the wheel, or to handles fixed at right angles to its rim. The steering-gear of a vessel is an illustration of this kind of lever. The wheel, axle and pulley are modifications of the lever of the first kind, the circumference of the wheel or pulley corresponding to the long arm; the axle or block to the short arm, the axis in both cases the fulcrum. The general law corresponds to that of the lever. Intensity of force is gained and time is lost in proportion as the circumference of the wheel

exceeds that of the axle. The advantage of the wheel and axle over the simple lever is the change of direction of power which it affords. The power, instead of being in the same straight line with the fulcrum and weight, may be applied at an angle. This is convenient in producing the rotation of a tooth.

In its application to regulating, the elasticity of the rubber band is the power; the tooth or teeth over which it passes is the fulcrum and the tooth to be moved the weight.

Fig. 293 illustrates the rotation of a tooth by having a gold band with an arm fitted to the tooth and a rubber band attached to the arm and stretched to the first bicuspid; as the tooth rotates, the arm is bent at right angles to the band. This appli-

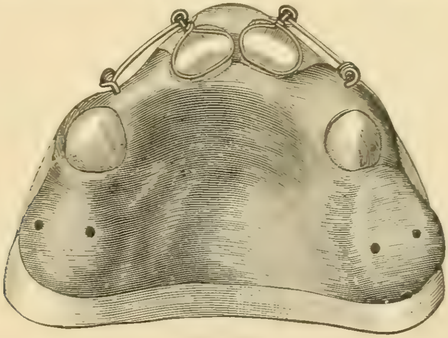


Fig. 314.

cation of the wheel and axle will accomplish the rotation of the teeth in the majority of cases.

It should be observed that the power of an elastic band is increased with the tension until this becomes greater than the strength of the material, when it will break. Hence, the greater the number of teeth over which it passes, the greater the power of the band; but at the same time it is lessened by the friction of the surfaces over which it passes.

The inclined plane—a plane surface inclined to the horizon at any angle—is used for raising weights. The longer the inclined plane, the easier it is to raise a body a given height. When the power acts parallel to the inclined plane, intensity of force is gained and time is lost in proportion as the length of the plane exceeds its height.

In dentistry this force has been found as of peculiar value

in cases where the arch is to be widened by an appliance; under such circumstances the teeth exert an outward pressure on the opposite jaw and the articulation of the cusps makes an inclined plane.

If the anterior superior teeth close inside of the inferior teeth they should be brought out with the lever, and if the inferior teeth be too short to exert a pressure on their opponents, they may be fitted with a platinum cap and cemented securely with zinc oxyphosphate. This arrangement maintains a constant outward pressure upon the superior teeth (Fig. 294). In the illustration a metal plate is fastened to the teeth by a ligature instead of an elastic band. Although I have had good results with this method, I do not consider it of any great value, for the

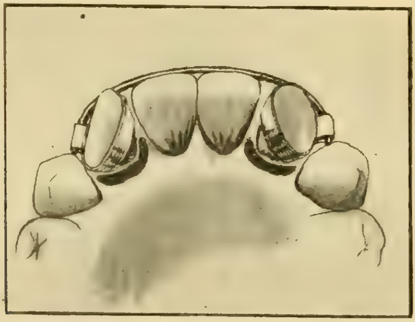


Fig. 315.

reason that as soon as the teeth begin to get sore to touch, pressure is unconsciously removed by the patient and the method proves in most cases to be a failure.

The wedge is a modification of the inclined plane. The power is applied with a hammer or a sledge to the back of the wedge. It is employed in various ways in ordinary mechanics, as in raising buildings, splitting wood, etc. It is an unsatisfactory force to calculate upon, because the large, flat surfaces produce so much friction. On the other hand, its friction is useful in retaining the wedge in its position. The power (acting parallel to the base instead of the inclined surface) counterbalances a weight as many times greater than itself as the height of the wedge is contained in the base. When applied to the teeth, the

wedge increases the diameter of the arc of a circle in which the teeth are implanted. It is usually made of fine-grained wood or India-rubber. It is a direct, positive, very effective force. Teeth with long roots, deep in the alveolar process, when the latter is dense and hard, are difficult to start with ordinary appli-

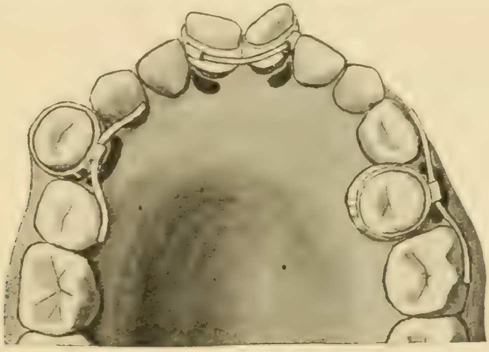


Fig. 316.

ances. In such cases the wedge is of great service. It will readily move one or two teeth and not infrequently three will be influenced by its pressure. Wedges made from orange wood are very serviceable, as they can be readily reduced in size as the case may require. When applied to the teeth they become saturated with saliva, swell, and in so doing force the teeth apart. When a rubber wedge is used one slightly larger than

Fig. 317.

the space between the teeth is selected and by its elasticity the teeth are spread. The rubber wedge performs its work with greater rapidity, perhaps, but it causes more pain than the wooden wedge. Owing to elasticity of rubber the teeth vibrate with each effort of mastication, whereas they are held firmly by the wooden wedge.

Each of the six mechanical forces has its proper place in the art of regulating teeth and when skillfully applied each is an effective agent. The application of these forces, however, is limited. Elasticity, as found in the spring of metals and India-rubber, combines much that is necessary to render effective either the most rudimentary deficient or the most intricate appliance. The simplicity of the application of this force makes it peculiarly suitable to dentistry.

Next to the screw, elasticity of metals gives more satisfaction in correcting deformities than any other appliance. Although it is not a positive force, yet it has the advantage of being readily held under control.

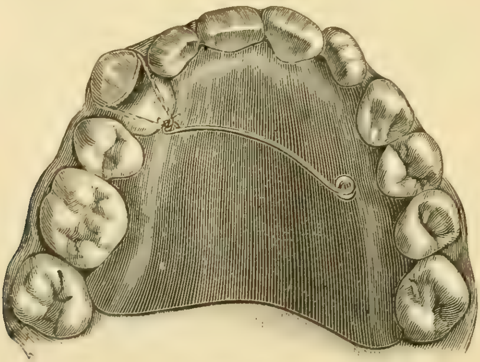


Fig. 318.

Metal molecules are held together by cohesion. These particles change in their relative positions when the metal is acted upon by an external force. If this force be removed before these changes exceed a certain limit, the particles return to their previous positions. This power of returning to original form is called elasticity. This elasticity of metāls may be utilized in regulating teeth with results only limited by the amount of spring which a metal possesses. There are many degrees of elasticity. A metal cannot be absolutely elastic; that it cannot go back exactly to its previous form. Every body is elastic in a degree. Gold belongs to the inelastics, alloyed with other metals (platinum) it becomes a markedly elastic metal.

German silver and piano wire are my favorite metals. A little appliance, which I have used for thirty years, has given as

much satisfaction in correcting irregularities of the teeth as the screw. Take commercial German silver plate and roll it to Nos. 29, 31 and 32, U. S. gauge. These thicknesses are required to obtain different strengths of metal. Cut into strips, take the thinnest strip, place flat nose pliers in the center (Fig. 295), and bend the strip the width of the tooth to be brought into line. Then with round nose pliers bend the ends in the opposite direction, just a little shorter than the adjoining teeth, cut and trim the corners and edges so that the lips and cheeks may not be injured; this is to be crowded into place. This affords double leverage, inasmuch as it draws one tooth in and the other out (Fig. 296). d is the weight, the proximal surfaces of the two

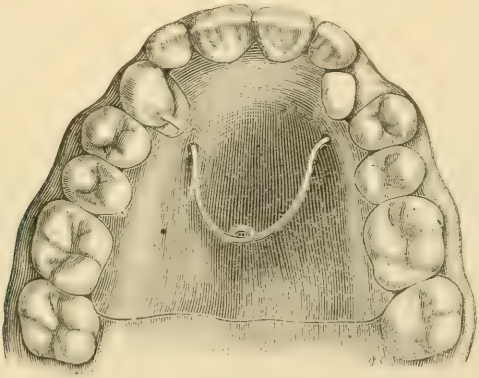


Fig. 319.

adjoining teeth at c are the fulcrum and a the power, or a the resistance, c the fulcrum and d the power. The strongest tooth affords, of course, the greatest resistance.

The power in cases like this depends largely on the elasticity and tenacity of the metal. If the intervening medium between the proximal surfaces of the resisting tooth and that of the tooth to be moved have little or no elasticity, the intervening medium will yield readily, and nothing can be accomplished.

Rolling the German silver into fixed thicknesses gives the metal its elasticity, hence it must not be heated after it is run through the mill. Fig. 297 shows some of the positions in which this metal may be used. All teeth, however, anterior to the first permanent molars may be brought from either direction

into line by this process. The surgical procedure is likewise here illustrated. The superior incisors situated just inside the lower may be brought into line without the use of a plate to keep the jaws apart. This appliance must be removed every day and with round nose pliers the ends are bent, the spring shortened and forced into place upon the tooth, so easily that caution must be observed not to exceed the intended results.

Piano wire manufactured in Germany, England and America is made of the best steel, drawn through a draw-plate to the required size; polish and temper are given during this process. The wire must be extremely pliable and strong to endure the tension which it undergoes during the tuning process of a piano. It must also be perfect in construction, since a flaw in the wire makes it to snap when being manipulated. It has great advan-


Fig. 320.


Fig. 321.

tages for dental purposes. It is inexpensive, has greater elasticity than other wires and can be more easily adapted to a variety of cases. It can be bent in any way necessary to obtain the greatest amount of force and can be applied to any place in the mouth, on account of its small size and weight. Sizes 18, 19, 20 are better suited to the majority of irregularities, the strength of the wire to perform a given operation depending upon the age and constitution of the individual and the character of the irregularity. In youth or in delicate organizations, No. 20 is the size best adapted to regulate; the sizes should decrease to No. 17 as the years advance, or as the stubbornness of the irregularity demands. The selection of the wire and adaptation to each special case so as to secure the best results and avoid inflammation requires nice discrimination.

In order to obtain the best results, the elasticity of the wire

was increased by coiling it from one to three times around a mandril. The idea of the coil in connection with piano-wire occurred to me at the 1881 International Medical Congress. These coil springs have been placed at the dental depots for the benefit of those who have not the time to make their own springs. The mandril is driven into the bench and with the right hand the wire is coiled about it as many times as required, the short end being held firmly by the left hand. The coil ends directly at the starting point and gives thereby the greatest elasticity and length of arms. When necessary, the long end of the wire can be bent with square-nose pliers to make it on the same plane with the other arm. Fig. 298 shows the coil spring.

The coil of the spring works on the same principle as the mainspring of an American watch, which, between two points, measures a uniform period of time. The extremities of the

Fig. 322.

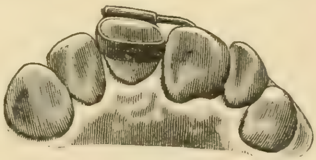


Fig. 323.

arms of the spring travel over a given space with like uniformity, which gives a mild uniform pressure to the jaws and teeth. The arms may be bent in any position and cut at any length to suit the case in hand. One or more coils may be used on the same wire. They may be used in connection with a rubber plate, or with bands of gold or platinum fastened to the teeth with zinc oxyphosphate. With holes properly drilled in the plate or bands and the arms fitted into them, the spring will stay in position. When the spring is used without a plate, it will be well to fasten the wire in some of the teeth to prevent its being swallowed, should it accidentally spring out of place.

The following histories illustrate some difficulties in practice:

The following models of the mouth of a sixteen-year-old girl, a patient of Dr. J. F. Austin, of Chicago, show a deformity I corrected. The right cuspid had encroached upon the lateral incisor to such an extent as to twist and force it out of position,

leaving only about one-half of the space necessary to rotate the tooth into place. A plate was made to fit the mouth and teeth and a coil-spring inserted, with arms meeting the cuspid and central incisor. The spring was secured to the plate by a pin driven into the plate (Fig. 299). By the lateral pressure of the spring the teeth were pushed apart, making space for the teeth to be rotated into place. Fig. 300 shows the tooth secured in position by the Magill retainer.

On an exact plaster model of the case to be regulated a thin, narrow vulcanite plate is formed, with a short, vertical post fixed, either before vulcanizing or afterward, by drilling centrally in

Fig. 324.

the plate on the median line. Grooves or slots are, with a wheel bur, cut in the sides of the plate to receive the ends of the spring and prevent its displacement after the coil has been placed on the post. Fig. 301 represents such an appliance in position on a plaster cast of the inferior maxilla of a boy aged twelve years and it will thus be seen that the movements of the tongue would not be, as in practice they were not, seriously restricted. The tension of the spring is changed by simply bending outward or inward its arms. In many cases the apparatus may be inserted or removed with great facility and its action so continued and controlled that required expansion is obtained and maintained.

by merely one plate. This plate, with spring attached, was removed by the boy twice a day and the teeth and plate cleaned.

In spreading the dental arch the majority of cases require the greatest pressure on the anterior teeth and an appliance that can be placed inside the arch will exert the greatest influence. The force is equally distributed on both sides of the mouth and if constant the work will be accomplished rapidly, without inconvenience to the patient. Such an appliance is here illustrated (Fig. 302). It was used in the mouth of a young girl fourteen years of age. A plate made to fit the teeth and alveolar process was cut away so that the anterior parts extend far enough forward to inclose the teeth to be moved. A piece of wire was bent to either of the forms shown in Fig. 303, wherein a is the

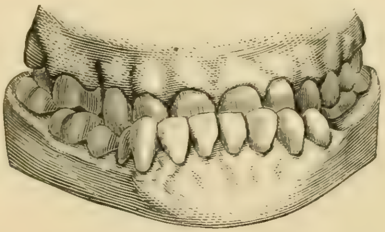


Fig. 325.

coil and fixed point and b b movable arms extending from a and also fixed points, cc, movable arms extending from b b.

Grooves were cut into the anterior and posterior parts of the plate to correspond with and receive the points b b and c c. Holes were drilled at these points and the wires tied to the rubber plates. In order that the anterior teeth may be moved with the greatest force, the arms are so adjusted that the greatest pressure is exerted on the anterior parts of the plates. This appliance is readily removed for cleansing and returned to place by the patient. A coil spring, however, with two points of attachment is not as efficient at the second as at the first point.

Another appliance for widening the dental arch that has been successfully used is illustrated in Fig. 304. It consists of a rubber plate made to fit the teeth and jaw. The plate is then sawed lengthwise—commencing at a point anterior to the teeth to be moved; a hole is drilled at the point where the slot stops to prevent the

arms breaking. At the extreme end holes are drilled to receive the spring. To adjust the plate press the arms together and drop the plate into place. Fig. 305 shows the plate out of the mouth. This can be removed and inserted by the patient.

A form of dental irregularity difficult to correct occurs when the cuspids are situated near or in contact with the centrals, while the laterals stand inside of the arch, and, when the jaws are closed pass behind the central incisors. If these laterals be in near relations, ordinary means do not interact upon them with sufficient pressure to force them apart; the space being quite too short to admit a jack-screw.

Fig. 306 represents such a condition. The cut is made from the cast of an eighteen-year-old woman, who came under care in 1883. The superior laterals were then only one-fourth of an inch apart and closed behind the inferior incisors. There were but small spaces between the superior centrals and cuspids.

Thin platinum collars were made to fit the laterals, on which after driling a hole in the side of each collar, they were firmly fixed with zinc oxyphosphate. A spring was bent into the form shown in Fig. 307, the ends of the arms being turned at a sharp angle and cut short as seen in the figure.

The spring was then put in place, the arm ends entering the holes in the collars and the curved arms were closely conformed to the surface of the gums and palatine parts so that the fixture, while no obstruction to occlusion, could be easily sprung out of position for cleansing purposes or for increasing the expansive power of the spring, by simply widening the lateral spread of the arms. Fig. 306 shows the progress made in four weeks' treatment. When the laterals had been moved past the sides of the centrals, they were by other means forced outward into line.

To force out central and lateral incisors, I have found the following methods useful: Around the tooth to be moved and around the molars, as nearly opposite the direction the incisor is to travel as possible, fit platinum collars. Solder cups upon the collars directly opposite and in line. Make a spring of piano-wire (Fig. 308) and spring it into the cups soldered upon the collars. In Fig. 309 the appliance is seen in place.

Another method is to make a plate to fit the teeth, thickening it nearly to the cutting edge of the tooth to be moved, and drilling a hole through the thickened part. Directly opposite, at some convenient point on the back part of the plate, drill another hole just deep enough to hold the spring in place (Fig. 310). If the hole in the thickened part be drilled in the proper place, the end of the spring will hit the tooth midway between its cutting-edge and the margin of the gum. The spring is very effective. The pressure is constant and the spring is readily removed for adjustment or for any other purpose.

A single tooth is often so situated inside the dental arch

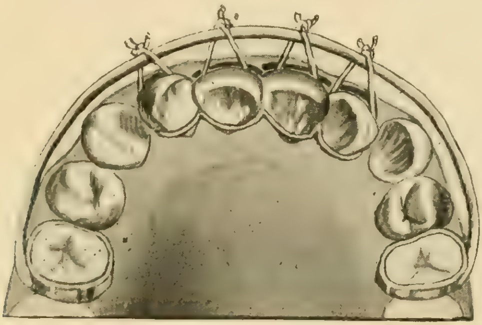


Fig. 326.

that there is trouble in contriving an apparatus suited to its correction.

The illustrations represent some simple appliances that have been thoroughly tested and found satisfactory; they do the work effectively, are easy of adjustment and removal and they may be readily cleansed.

Fig. 311 illustrates a second inferior bicuspid of the right side, having a lingual presentation equal to one-half the thickness of the tooth inside of its normal position. The cut also shows teeth in other malpositions.

For this case a thin, narrow, close-fitting vulcanite plate was made, and a hole was drilled through the middle of the plate opposite the center of the tooth to be moved. In the other side another hole was drilled, but not quite through the plate. A suitable spring (Fig. 312) was then made of piano-wire, having a single coil, A, and the ends of its arms bent at about a right

angle. One of these ends, C, was cut short to enter the corresponding hole in the plate, and the other end, B, left long enough to go through the plate and impinge on the lingual surface of the bicuspid, leaving a full eighth of an inch between that arm of the spring and the plate, as is clearly shown by Fig. 311. Fig. 313 shows both arms, B B, of the same length, to pass through the plate and impinge on lingual surfaces of teeth upon opposite sides.

Fig. 314 shows an appliance for pulling out the central incisors. A plate is made to fit the jaw and teeth and into it were vulcanized two of the Talbot springs at the lateral incisor region. The wire arms were turned into loops at the extremities to secure a ligature. When the plate was adjusted, the arms were bent horizontally and brought in close proximity to the labial surfaces of the central incisors and securely tied. By this means constant pressure was applied and the teeth were carried outside of the inferior incisors. Moving individual teeth in or out into line or rotating them in their sockets by the use of piano-wire is illustrated in Fig. 315 and Fig. 316. The surgical procedure is likewise demonstrated.

I have succeeded in erupting teeth by the following method: Fig. 317 illustrates the right superior lateral arch of an eighteen-year-old boy. At about the tenth year I was able to indicate in outline the crown and root of the cuspid and noticed the marked obliquity of its position. The posterior column was crowding the bicuspids forward so that they eventually filled the space allotted to the cuspid. The teeth in the left superior lateral arch came into position in the natural order, and that arch was nearly normal. I waited until the point of the cuspid made its appearance, extracted the first bicuspid. Platinum bands were fitted to the second bicuspid and lateral incisor and these were connected with a bar of platinum extending to and impinging upon the central incisor. A flat tube was then soldered to the bar for the purpose of securing a coiled spring, made of the smallest size piano-wire, the arms being cut to about the same length. One arm was doubled upon itself and so adjusted that when it was passed into the flat tube the suitably bent end of the other arm would reach forward and catch upon

the point of the cuspid. The alveolar process was then cut away, care being taken not to injure the outer plate and periosteum. By this means the cuspid was swung backward and pulled downward until the crown was in direct line with the position it was to occupy when in place. An impression was then taken and a vulcanite plate made (Fig. 318), in which another spring of piano-wire was inserted in such a manner that when properly adjusted the end of the arm reached over and just inside of the space of the cuspid. A ligature was then tied around the neck of the tooth and the arm of the spring drawn close to the crown and fastened. By glancing at Fig. 318 it will be observed that the action of the spring must be to draw the tooth not only down, but also inward to its position. In locating the spring in the plate, the position of the crown

Fig. 327.

before and after it is brought into place must not be lost sight of. When the spring is applied for the purpose of drawing the tooth out of the alveolar process, the patient must be seen every day, because in most cases this movement is so easily accomplished that only twenty-four hours are necessary to complete the operation. If, on the other hand, two or more days supervene before the patient is seen, the tooth would be erupted further than is required.

Teeth wholly imbedded in the jaw may be erupted with a spring, as shown in Fig. 319, by first removing a piece of mucous membrane and alveolar process over the crown with Rollins' revolving knife. The advantages of this peculiar kind of spring in these difficult cases are: 1st, it can be adjusted to any special angle required, and, 2nd, the force is constant and need not be readjusted for three or four days after it is applied (if the move-

ment be not rapid), thus relieving the operator and patient from the expenditure of time in frequent office attendance.

A form of irregularity of the teeth is occasionally observed wherein the cuspids erupt inside of the arch. Sometimes the case presents, when the point of the cusp has just penetrated the mucous membrane of the mouth, and again the tooth will have erupted its normal length. Frequently it will erupt in close contact with the lateral incisor and first bicuspid, or it may make its appearance in the roof of the mouth. Occasionally only one cuspid will be misplaced. Again, both cuspids will thus erupt out of position. Fig. 319 illustrates an instance of this kind occurring in the mouth of a sixteen-year-old girl. Both cuspids were in process of eruption inside the arches and in contact with the adjoining tooth. The roots could be outlined on the outer alveolar plate as far as their apices, demonstrating the fact that the crypts containing the crowns were originally in normal positions, but that their crowns had subsequently pointed toward the roof of the mouth. A vulcanite plate was made and a hole drilled through it so that the point of a wire spring would touch the cuspid just above the margin of the gum. On the opposite side of the plate a hole was drilled just deep enough to hold the other end of the spring when in position. A cap was cemented and a small hole drilled in it to prevent the spring from slipping when adjusted in position. A strong spring was made of piano-wire, No. 17 or 18 U. S. gauge, and the ends bent at right angles. One of the ends was cut short to fit into the hole made in the plate opposite the tooth to be moved, the other end left long enough to pass through the plate and sharp-pointed to enter a hole in the band of the tooth to be moved. The alveolar process was then cut away in the direction of the moving tooth. In many cases such a spring will keep the plate in position, but should the plate slip it may be fastened to the bicuspid with ligatures.

Fig. 320 illustrates the left side of the lower denture of a thirteen-year-old boy. The second deciduous molar had been retained in the jaw beyond the natural period and its mesial and distal surfaces had been so destroyed by caries that the first permanent molar had come forward and greatly diminished

its normal distance from the first bicuspid. The removal of the deciduous molar left an insufficient space for the accommodation of the coming second bicuspid, which consequently had become locked between the molar and first bicuspid, so that complete eruption was impossible.

A narrow vulcanite plate was made and a coiled wire spring was so applied as to force the teeth apart. When sufficient room had been gained, a cavity was formed in the crown of the second bicuspid and small wire eye-bolt set in the cavity with amalgam. Another coiled wire spring was fixed in the plate and the spring lever inserted in the eye of the bolt, as shown in Fig. 321. The lifting action of the spring soon compelled the eruption of the bicuspid into its proper position and relations with the occluding teeth.

The removal of the eye-bolt after cutting away the amalgam

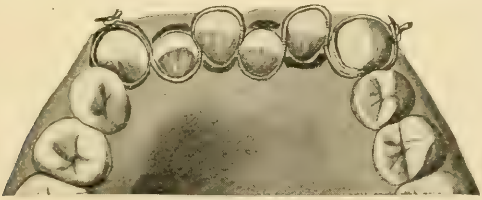


Fig. 328.

with a small round bur and the subsequent filling of the small cavity with gold completed the operation.

Obviously a ligature could have been forced down upon the submerged crown of the bicuspid and the loop-hitch of the ligature be made a substitute for the eye-bolt. This was preferred as a more positive means of attachment to the lifting spring lever.

June, 1884, the following treatment was begun for rotating the central incisor of a patient. A platinum band was made to fit the tooth and a tube of the same material was soldered lengthwise with the band (Fig. 322). The band was secured to the tooth with zinc oxyphosphate, a piece of piano-wire being passed into the tube and allowed to extend to the left central incisor (Fig. 323). The wire was bent every day and the tooth thus rotated into place. When practicable a flat tube should be soldered to the band for the purpose of holding a flat lever, which

would prevent the rotation of the arms. For rotating a tooth the most efficient contrivance is the combined lever and collar, fitting and fixed upon the tooth by cement (Fig. 324). The soldering of a flattened tube across the face of the collar affords a means for the insertion and removal of the lever at will.

I prefer a lever made of a piece of thin piano-wire, No. 27, U. S. gauge, one end of which is folded upon itself for about a quarter of an inch and the wire then coiled once or twice close to the folded end (see illustration). The other end is bent to hook around a molar or other posterior tooth. The illustration shows such a tubed collar and wire lever separately and also in place on the tooth which is to be rotated. It is obvious that the lever can be removed or applied without detaching the cemented collar. In operation, the compound lever effects a complex movement of the tooth, which is being rotated by the lever as a whole and is at the same time thrown outward by the hinge-like action of the short lever turning on the coil as on an axis—the result being the proper alignment of the tooth, if the spring of the coil and the elasticity of the lever be judiciously adapted to the case.

The other central incisor can likewise be simultaneously rotated, and, after both teeth had been brought into position, a folded wire bar through both tubes would retain them in place so long as might be deemed desirable.

Elastic bands cut from French rubber tubing are applicable to every case of irregularity of the teeth. Elasticity is peculiarly adapted to the correction of irregularities, because of its constant equable pressure, which may be increased or diminished by varying the size of the bands. This constant pressure produces rapid absorption of the bone, which opposes the restoration of the tooth to its normal position.

When the rubber bands are applied to the teeth, the point of resistance becomes very important. The resistance must equal or exceed that of the body to be moved; otherwise, the weaker will be moved by the stronger force. If a tooth upon one side be irregular, a tooth, or if necessary, several teeth, at the opposite point must be selected to withstand the pressure of the tooth to be moved. This requires thorough knowledge of the anat-

omy of the teeth and jaws and ability to judge comparative resistance of each tooth.

When the rubber bands are employed in cases requiring much force, it is generally a good plan to fit a rubber plate to the teeth and jaw, to which arms of rubber or gold are attached in such a manner that the teeth may be drawn in or out, as the case requires. The plate should be fastened by ligatures to fix teeth, and acts as the point of resistance. Rubber bands cut from tubing (or better, from rubber dam, as suggested by Dr. G. V. Black) are attached to the arms and carried over the teeth to be moved. Fig. 325 is from the model of the teeth of a fourteen-year-old boy. The lower jaw occludes outside the upper. A piece of gold wire (Fig. 326) was bent to the contour of the dental arch, allowing a space of 3-16 of an inch between the teeth and the wire and soldered to two bands attached to the second bicuspids (first bicuspids or molars may be used if desired). The surgical procedure is also illustrated. Rubber

Fig. 329.

Fig. 330.

dam rings were fastened to the band and carried over the incisors and cuspids. These teeth were dried and cleansed with alcohol. Zinc oxyphosphate was then mixed until it became sticky, when it was placed upon the lingual surfaces of the teeth for the purpose of holding the bands. Protruding teeth may be brought into line in the same manner by reversing the wire, placing it upon the inside of the mouth and proceeding as before. The teeth were in a short time brought out into place by the attachment of rubber rings to the gold band and over the teeth. The result is illustrated in Fig. 327.

Teeth may be rotated in their sockets with rubber bands in the following manner: Cut away the alveolar process. Fit a band of platinum accurately to the crown and solder. Make a hook by inserting and soldering a pin from an artificial tooth into a hole drilled in the labio-distal angle of the band. Fasten this band upon the tooth with zinc oxyphosphate. Attach a band of rubber at one end to the hook and at the other to a bicuspid, the tooth being thus rotated into place. Another

plan: dry the tooth, coat it with sandarac varnish and while moist wind about it a strip, cut from rubber dam, three-sixteenths of an inch wide and two inches long, with a string tied in its middle, so that the rubber dam doubles upon itself. Zinc oxyphosphate may be used upon the tooth for the same purpose. The band should be wound in the same direction in which the tooth is to be rotated and the winding should be continued until the end of the rubber reaches the distal edge of the tooth; the string should now be drawn across the mouth and tied to a molar or bicuspid tooth. This has not been as successful as the use of the Chinese grass line.

Ligatures are cords, strings, or wires for regulating and binding the teeth for the attachment of other appliances to the teeth or for holding them securely after they have found their places. Silk, linen or Chinese grass (raw silk fish line) ligatures serve a good purpose. When ligatures are used to regulate, they act upon the teeth to be moved by attaching them to a fixed point and also by the shrinkage of the fiber when moistened. Care should be taken in tying the knot of a ligature to avoid its working up under the gum. Various knots can be made for this purpose. Since the introduction of Dr. Magill's band for regulating teeth, the ligature has become a very useful adjunct for fastening appliances at any point upon the band where a pin or tube has been previously soldered. The raw silk fish line has been found far superior to any ligature or rubber band, since, as it contracts, it holds the tooth steady, therefore prevents soreness on account of vibration.

A quicker and easier method of holding ligature wire or rubber bands to teeth to prevent their slipping is to wipe the tooth dry, clean it thoroughly with 95-per-cent alcohol and mix zinc oxyphosphate into a sticky paste, apply this to the tooth or teeth and allow it to dry before coming in contact with moisture. Ligatures may then be fastened to the teeth without fear of slipping.

To rotate teeth, double the silk, pass the loose ends through the loop and apply it to the tooth to be rotated and fasten the end to a bicuspid or molar. To regulate the six anterior inferior teeth make a figure of 8 knot (Fig. 328). Figure of 8 knot may

be used with the upper teeth in the same manner. Teeth may be moved in or out. The ingenuity of the operator will devise other operations on similar principles.

Dr. Guilford's retainer consists of a band of gold or platinum (Fig. 329) swaged or fitted accurately to the tooth and of sufficient strength to resist the rotary strain and friction in mastication. By trimming the labial surfaces as narrow as compatible with strength, the band will not appear conspicuous. The bands, bars or levers may be therefore firmly soldered for rotating or retaining the teeth after regulating. Fig. 330 shows the application of two of these bands when two teeth are secured in position by a bar extending past fixed teeth on both sides. When two or more teeth are to be held in position, the bands may be secured to the bicuspids or molars on both sides and a bar

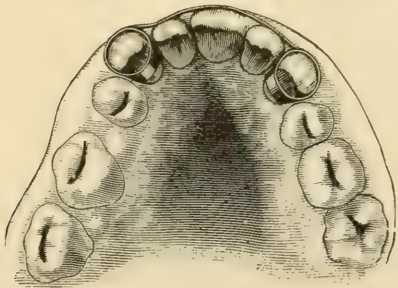


Fig. 331.

of gold extended from one to the other, upon the lingual or labial surface, as illustrated in Fig. 331. "Platinum bands were fitted to the two cuspitds and these were connected by a very thin platinum wire passing along and conforming to the outline of the labial surfaces of the incisors." A method of retaining two or more teeth in position is illustrated in Fig. 332. It consists of bands of gold, platinum or German silver, made in such a manner that only one thickness of the metal goes between the teeth. This was a case where the four anterior teeth were held in place by uniting them to the cuspids. Bands made in this manner do not leave spaces between the teeth.

Talbot's retainer consists of a band of platinum or gold fitted to the tooth or teeth, with a tube of the same material, the width of the tooth, soldered lengthwise of the band, as illustrated in Fig. 333. The band is fastened to the tooth with zinc oxyphos-

phate and a piece of gold, platinum or piano-wire is passed through the tube and allowed to come in contact with the surface of a firm tooth. Should the tooth that has been regulated move, the wire may be so bent that the tooth is restored to its proper position. Two or more teeth may be retained at any locality in the mouth in the same manner. The tube may be attached to the labial, buccal, palatine or lingual side of the band, according to the requirements of the case.

After the retaining appliance has been cemented to the teeth, tincture of iodin should be applied every other day to reduce the inflammation in the alveolar process. This will require from

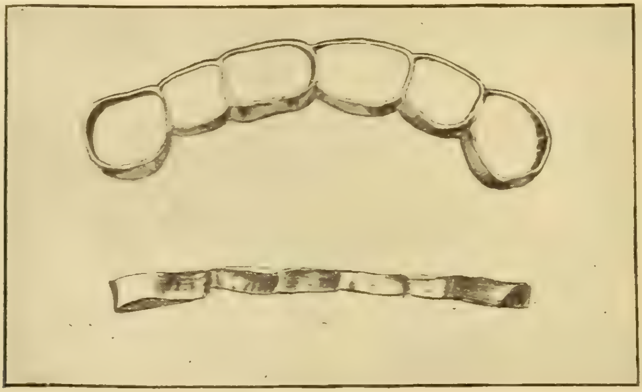


Fig. 332.

two to four weeks. Two elements governing the time required to retain the plate upon the teeth are, first, the age of the patient; second, the nature of the operation. The time cannot be definitely stated for all persons, even of the same age and condition of cases; approximation only is possible. In young and healthy persons, in whom reconstruction of tissue is rapid, the retainer will be needed but a short time. If the superior or inferior arches have been enlarged a retaining plate must be worn until all the teeth have accommodated themselves to their new position—a period that will vary from six months to a year.

Where the teeth have been forced into the arch little or no retention will be required, the pressure of the lips and cheeks often being all that is necessary. Occlusion of the teeth of

the opposite jaw aids greatly in retaining the bicuspids and molars.

The most difficult teeth to retain are those that have been rotated in their sockets. The difficulty of correcting the tendency to return to their original positions is so great that the retainers must be kept in place from one to two years and occasionally even longer. The operator will have to use his best judgment as to the proper time to remove them. The number of teeth being moved does not affect the time required, as the bone is as rapidly deposited in one part of the jaw as another. The health of the patient will have considerable influence in the time required. A strong, robust person will recover from the operation more rapidly than one that is anæmic. The retainer should remain as long as circumstances will warrant, when a model should be secured. After the lapse of not longer than a day an examination should be made and the appliance adjusted.

Fig. 333.

If the teeth have not deviated, a week may elapse before making another examination, when the appliance should again be adjusted. These examinations should be continued until the operator is satisfied the teeth are secure. If the teeth should move, the retainer must be replaced and allowed to remain from three to six months, when it can be removed and if any deviation is noted, it should be returned and worn until the teeth will remain as desired.

The movement of the teeth is always a predisposing cause of interstitial gingivitis. The interstitial gingivitis set up in the alveolar process is often difficult to reduce. Occasionally a low form of inflammation will remain many years, if not throughout life. The use of iodin is here indicated. It is a good plan to use it in all cases after the teeth have been properly secured in place. The tissues will recover much more rapidly and the chances of success more satisfactory.

APPENDIX.

TABLE I.

Crania of Modern and Ancient Races: Hunterian and Oxford University Museums and Private Collections.
By Dr. Mummery.

MODERN AND ANCIENT RACES.	No.	LATERAL DIAMETER.					
		MINIMUM.		MAXIMUM.		AVERAGE.	
		In.	Mm.	In.	Mm.	In.	Mm.
ESQUIMAUX	69	2.375	60.32	2.750	69.85	2.562	65.07
NORTH AMERICANS (Coast)	56	2.375	60.32	2.750	69.85	2.562	65.07
NORTH AMERICANS (Interior)	23	2.375	60.32	2.625	66.68	2.500	63.50
SOUTH AMERICANS (Chili)	19	2.500	63.50	2.750	69.85	2.625	66.67
FIJI ISLANDERS	38	2.500	63.50	2.875	73.02	2.687	68.26
POLYNESIANS (Various)	79	2.375	60.32	2.625	66.68	2.500	63.50
SANDWICH ISLANDERS	21	2.375	60.32	2.625	66.68	2.500	63.50
NEW ZEALANDERS	67	2.500	63.50	2.875	73.02	2.687	68.26
AUSTRALIANS	132	2.375	60.32	2.750	69.85	2.562	65.07
TASMANIANS	33	2.375	60.32	2.625	66.68	2.500	63.50
MALAYS	24	2.375	60.32	2.750	69.85	2.562	65.07
CHINESE	27	2.250	57.14	2.625	66.68	2.437	61.91
EAST INDIANS (North)	152	2.250	57.14	2.750	69.85	2.500	63.49
EAST INDIANS (South)	71	2.125	53.97	2.500	63.50	2.312	58.73
AFRICANS (East)	33	2.125	53.97	2.750	69.85	2.437	61.91
CAFFRES	49	2.375	60.32	2.875	73.02	2.625	66.67
BOSJESMEN and HOTTENTOTS	29	2.125	53.97	2.375	60.32	2.250	57.14
AFRICANS (West)	236	2.250	57.14	2.750	69.85	2.500	63.50
ASHANTEES	92	2.500	63.50	2.875	73.02	2.687	68.26
ANCIENT BRITONS (Dolichocephalic)	68	2.125	53.97	2.625	66.68	2.375	60.32
ANCIENT BRITONS (Brachycephalic)	32	2.125	53.97	2.500	63.50	2.312	57.73
ANCIENT BRITONS (Canon Greenwell's Explorations)	59	2.125	53.97	2.500	63.50	2.312	58.73
ANCIENT BRITONS (Miscellaneous)	44	2.125	53.97	2.500	63.50	2.312	58.73
ROMANO-BRITONS	143	2.125	53.97	2.625	66.68	2.375	60.32
ANGLO-SAXONS	76	2.250	57.14	2.625	66.68	2.437	61.91
ANCIENT EGYPTIANS	36	2.125	53.97	2.625	66.68	2.375	60.32

TABLE II.

Crania: Peabody Museum, Harvard University; Academy of Natural Sciences, Philadelphia; Davenport Academy; Army Museum; Roman, French, and English Crania in European Museums and Private Collections; Miscellaneous Crania. By Doctors Peirce, Newton, Schuhmann, Barrett, Pratt, Betty, and Talbot.

RACE.	No.	Sex.	LATERAL DIAMETER. Minimum. In.	Minimum. Mm.	Maximum. In.	Maximum. Mm.	Average. In.	Average. Mm.
Europeans—Ancient and Modern Romans, Italians, French, English.	276	?	1.94	49.19	2.69	68.26	2.34	58.84
	36	M	2.06	52.32	2.37	60.30	2.20	55.95
	30	F	1.88	47.62	2.44	61.90	2.08	52.81
Sandwich Islanders	26	M	2.13	53.95	2.50	63.50	2.29	58.17
	26	F	2.06	52.32	2.37	60.30	2.20	55.95
	8	?	2.22	56.35	2.50	63.50	2.30	58.45
Ancient Peruvians	137	M	2.00	50.80	2.63	66.67	2.30	58.45
	124	F	1.88	47.62	2.56	65.08	2.22	56.34
	117	?	2.00	50.80	2.56	65.08	2.30	58.45
Ancient Californians, from Santa Cruz Islands, Coast of California; Santa Catalina Island, Brazil; Nicaragua, St. Miguel	34	M	2.06	52.32	2.63	66.67	2.31	58.84
	38	F	2.06	52.32	2.44	61.90	2.25	57.14
Mexicans	27	?	1.94	49.19	2.50	63.50	2.31	58.84
Californian Indians	29	M	2.06	52.32	2.50	63.50	2.31	58.84
	26	F	2.06	52.32	2.37	60.30	2.22	56.34
Mound Builders, Mounds in Kentucky and Tennessee	56	M	2.06	52.32	2.63	66.67	2.33	59.48
	47	F	2.00	50.80	2.50	63.50	2.28	57.92
	57	?	2.06	52.32	2.69	68.26	2.39	60.70
Stone Grave People, Cumberland Valley, Tennessee; Illinois River, Indiana, Arkansas, Michigan, and various places	87	M	2.13	53.95	2.69	68.26	2.42	61.90
	89	F	1.88	47.62	2.50	63.50	2.28	57.92
	11	?	2.13	53.95	2.44	61.90	2.28	57.92
Indians—North American. Different Tribes	17	M	2.13	53.95	2.50	63.50	2.30	58.45
	11	F	2.13	53.95	2.31	58.84	2.23	56.69
	191	?	1.88	47.62	2.63	66.67	2.31	58.84
Negro—Rio de Favino	1	..	2.19	55.56	2.19	55.56	2.19	55.56
Flat Heads from Oregon, Washington, Gulf of Georgia, Peru	3	M	2.25	57.13	2.50	63.50	2.45	62.31
	2	F	2.13	53.95	2.44	61.90	2.28	57.92
	18	?	2.25	57.13	2.75	69.85	2.53	64.29
From San Lorenzo Cave, Mexico	4	M	2.25	57.13	2.37	60.30	2.30	58.45
	3	F	2.13	53.95	2.37	60.30	2.20	55.95
From Caves in Tennessee, Kentucky, Mexico	4	M	2.13	53.95	2.19	55.56	2.14	54.38
	9	?	....	.....	....	.....	2.23	56.69
	3	F	2.06	52.32	2.25	57.13	2.19	55.56
Esquimaux from Labrador, Norton Sound	40	?	1.75	44.46	2.63	66.67	2.23	56.69
	2	M	2.25	57.13	2.31	58.84	2.28	57.92

TABLE II—Continued.

RACE.	No.	Sex.	LATERAL DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
HINDOOS	1	M	2.13	53.95	2.13	53.95	2.13	53.95
	1	?	2.22	56.35	2.22	56.35	2.22	56.35
	3	F	2.06	52.32	2.37	60.30	2.25	57.14
HERNEY ISLANDERS	3	M	2.19	55.56	2.50	63.50	2.33	59.13
	1	?	2.13	53.95	2.13	53.95	2.13	53.95
HAWAIIAN ISLANDER	1	M	2.31	58.84	2.31	58.84	2.31	58.84
NEGROES, African Negroes	2	M	2.13	53.95	2.50	63.50	2.31	58.84
	9	?	1.88	47.62	2.47	62.70	....	57.58
	79	F	2.25	57.13	2.25	57.13	2.25	57.13
ZULUS, South Africa	1	F	2.25	57.13	2.25	57.13	2.25	57.13
	1	M	2.44	61.90	2.44	61.90	2.44	61.90
PROBABLY AFRICANS	2	F	2.00	50.80	2.25	57.13	2.13	53.95
NEGRO CRIMINAL (Giles)	1	M	2.31	58.84	2.31	58.84	2.31	58 84
ALEUTIAN ISLANDER	1	F	2.13	53.95	2.13	53.95	2.13	53.95
GUANCHE	1	F	2.06	52.32	2.06	52.32	2.06	52.32
PEGU, Burmah	1	F	2 19	55.56	2.19	55.56	2.19	55.56
MAURITIAN DWARF	1	?	2.19	55.56	2.19	55.56	2.19	55.56
UNKNOWN	3	M	2.31	58.84	2.44	61.90	2.37	60.30
	5	F	1.88	47.62	2.31	58.84	2.13	53.95
FIJI ISLANDERS	2	?	2.31	58.84	2.44	61.90	2.37	60.30
LOO CHOO ISLANDER	1	?	2.37	60.30	2.37	60.30	2.37	60.30
BURMESE	1	?	2.47	62.70	2.47	62.70	2.47	62.70
MARQUESAS ISLANDERS	4	?	2.28	57.92	2.44	61.90	2.36	59.91
ASSINIBOIN	3	?	2.28	57.92	2.37	60.30	2.31	58.84
KANKAKEE	5	?	2.16	54.75	2.31	58.84	2.25	57.14
MALAY	13	?	2.16	54.75	2.53	64.29	2.37	60.30
TAHITIAN	2	?	2.25	57.13	2.47	62.70	2.36	59.91
TATLIT KOOCHIN	2	?	2.22	56.35	2.34	59.57	2.28	57.92
LAPLANDERS	2	?	2.37	60.30	2.50	63.50	2.44	61.90
JAPANESE	1	?	2.37	60.30	2.37	60.30	2.37	60.30
PARSEE	2	?	1.97	50.07	2.00	50.80	1.98	50.40
AUSTRALIANS	10	?	2.09	53.13	2.69	68.26	2.31	58.84
ARMENIANS	4	?	2.00	50.80	2.09	53.13	2.06	52.29
SAMOAN ISLANDER	1	?	2.25	57.13	2.25	57.13	2.25	57.13
ANCIENT EGYPTIAN (Egyptian Type)	45	?	1.88	47.62	2.22	56.35	2.06	52.59
			1.88	47.62	2.50	63.50	2.20	55.95
ANCIENT EGYPTIAN (Negroid Type)	11	?	2.13	53.95	2.69	68.26	2.37	60.30
COPT	1	?	2.13	53.95	2.13	53.95	2.13	53.95
EGYPTIAN NEGROES	3	?	1.88	47.62	2.13	53.95	2.01	51.05
ARAB	2	?	2.19	55.56	2.31	58.84	2.25	57.14
CHOCTAW and NEGRO	1	?	2.19	55.56	2.19	55.56	2.19	55.56
HISPANO-PERUVIAN	2	?	2.13	53.95	2.22	56.35	2.17	55.16
DUTCH	1	?	2.56	65.08	2.56	65.08	2.56	65.08
ANGLO-AMERICAN	1	?	2.50	63.50	2.50	63.50	2.50	63.50
RECENT CRANIA, Pa. (?)	22	?	1.97	50.07	2.50	63.50	2.30	58.45
Total	1840		1.88	47.62	2.69	68.26	2.28	57.94

TABLE III.

Measurement of the Superior Maxilla in Life.

RACE.	No.	Sex.	LATERAL DIAMETER. Minimum. In.	Minimum. Mm.	Maximum. In.	Maximum. Mm.	Average. In.	Average. Mm.
Residents of Athens, Greece	15	M	1.75	44.46	2.13	53.95	1.98	50.40
	14	F	1.75	44.46	2.02	51.30	1.90	48.23
Stockholm, Sweden	393	M	1.88	47.62	2.63	66.67	2.26	57.37
	194	F	1.75	44.46	2.60	66.00	2.15	54.60
Copenhagen, Denmark	250	M	1.75	44.46	2.56	65.00	2.24	56.82
	50	F	1.75	44.46	2.46	62.50	2.18	55.72
Brussels, Belgium	148	M	1.97	50.02	2.56	65.00	2.25	57.05
	158	F	1.75	44.46	2.60	66.00	2.18	55.57
Warsaw, Poland	150	M	2.02	51.30	2.60	66.00	2.31	58.84
	150	F	1.94	49.25	2.40	61.00	2.17	55.16
China	72	M	2.00	50.80	2.44	62.00	2.26	57.37
	22	F	2.00	50.80	2.52	64.00	2.19	55.56
East Indians	46	M	1.94	49.25	2.37	60.30	2.13	53.95
	3	F	1.94	49.25	2.07	52.50	2.00	50.80
Italians	666	M	1.94	49.25	2.63	66.67	2.17	55.16
	189	F	1.88	47.62	2.44	62.00	2.00	50.80
Santiago, Chile	106	M	1.75	44.46	2.40	61.00	2.11	53.57
	154	F	1.75	44.46	2.34	59.57	2.04	51.78
London, England	203	M	1.88	47.62	2.63	66.67	2.28	57.92
	187	F	1.88	47.62	2.44	62.00	2.09	53.19
Dublin, Ireland	86	M	1.88	47.62	2.63	66.67	2.25	57.13
	126	F	1.88	47.62	2.52	64.00	2.11	53.52
American-born Negroes	128	M	2.07	52.50	2.52	64.00	2.32	58.98
	108	F	1.97	50.02	2.31	58.84	2.20	55.90
Dispensary — Philadelphia, Baltimore, and Boston	463	M	1.88	47.62	2.56	65.00	2.14	54.33
	241	F	1.75	44.46	2.63	66.67	2.01	50.90
Burlington, Vermont	52	M	1.97	50.02	2.37	60.30	2.19	55.56
	50	F	1.88	47.62	2.20	56.00	2.02	51.31
Boston, Massachusetts	896	..	1.94	49.25	2.31	58.84	2.04	51.80
New York City	47	M	1.75	44.46	2.52	64.00	2.18	55.72
	56	F	1.75	44.46	2.52	64.00	2.10	53.36
Chicago and Illinois	1696	M	1.75	44.46	2.52	64.00	2.12	53.76
	1116	F	1.75	44.46	2.52	64.00	2.02	51.31
Marshpee Indians	55	M	2.00	50.80	2.52	64.00	2.24	56.90
	6	F	2.07	52.50	2.07	52.50	2.07	52.50
Total	8296		1.87	47.54	2.41	62.08	2.14	51.19

TABLE IV.

RACE.	No.	Sex.	ANTERO POSTERIOR DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
ANCIENT AND MODERN ROMANS, LAKE DWELLERS, FRENCH prior to nineteenth century..............	31	M	1.69	42.86	2.00	50.80	1.86	47.23
	30	F	1.56	39.69	2.06	52.32	1.83	46.43
SANDWICH ISLANDERS.......	26	M	1.63	41.28	2.19	55.56	1.91	48.38
	29	F	1.63	41.28	2.03	51.56	1.83	46.43
ANCIENT PERUVIANS........	122	M	1.56	39.69	2.13	53.95	1.88	47 62
	104	F	1.56	39.69	2.13	53.95	1.79	45.64
	2	?	1.69	42.86	1.94	49.14	1.84	46.83
ANCIENT CALIFORNIANS.....	26	M	1.63	41.28	2.13	53.95	1.89	48.02
	32	F	1.69	42.86	2.06	52.32	1.86	47.23
	130	?	....	.....	....	.....	1.83	46.40
CALIFORNIAN INDIANS.......	32	M	1.69	42.86	2.13	53.95	1.91	48.38
	30	F	1.69	42.86	2.00	50.80	1.83	46.43
MOUND BUILDERS..........	157	M	1.56	39.69	2.31	58.69	2.00	50.80
	83	F	1.63	41.28	2.13	53.95	1.89	48.02
	1	?	2.00	50.80	2.00	50.80	2.00	50.80
STONE GRAVE PEOPLE—Cumberland Valley.......	83	M	1.63	41.28	2.25	57.03	1.97	50.00
	80	F	1.63	41.28	2.06	52.32	1.91	48.41
	7	?	1.88	47.62	2.00	50.80	1.94	49.21
INDIANS....................	110	M	1.75	44.46	2.31	58.69	1.99	50.55
	58	F	1.38	35.09	2.31	58.69	1.87	47.44
	3	?	1.81	46.04	2.00	50.80	1.91	48.38
NEGRO—Rio de Favino.......	1	?	2.06	52.32	2.06	52.32	2.06	52.32
FLAT HEADS from Oregon, Washington, Georgia, Peru....................	3	M	1.88	47.62	2.25	57.13	2.00	50.80
	2	F	1.88	47.62	2.00	50.80	1.94	49.21
	1	?	2.00	50.80	2.00	50.80	2.00	50.80
From San Lorenzo Cave, Mexico..................	4	M	1.69	42.86	2.00	50.80	1.83	46.43
	3	F	1.75	44.46	1.94	49.14	1.83	46.43
From Caves in Tennessee, Kentucky, Mexico........	4	M	1.69	42.86	1.88	47.62	1.79	45.64
	....	?	....	.....	....	.....	....	.....
	3	F	1.75	44.46	2.00	50.80	1.83	46.43
ESQUIMAUX from Labrador, Norton Sound............	....	?	....	.....	....	.....	....	.....
	7	M	1.69	42.86	2.13	53.95	1.72	43.65
HINDOOS	4	M	1.69	42.86	2.00	50.80	1.69	42.86
	....	?	....	.....	....	.....	....	.....
	2	F	1.81	46.04	1.81	46.04	1.81	46.04
HERNEY ISLANDERS	3	M	1.88	47.62	2.00	50.80	1.92	48.81
	....	?	....	.....	....	.....	....	.....
HAWAIIAN ISLANDER	1	M	2.00	50.80	2.00	50.80	2.00	50.80
NEGROES, African Negroes..	2	M	2.06	52.32	2.13	53.95	2.09	53.18
	....	?	....	.....	....	.....	....	.....
	....	F	....	.....	....	.....	....	.....
ZULUS, South Africa.......	1	F	1.94	49.14	1.94	49.14	1.94	49.14
	1	M	2.00	50.80	2.00	50.80	2.00	50.80
PROBABLY AFRICANS..........	....	F	....	.....	....	.....	....	.....
NEGRO CRIMINAL...........	1	M	2.19	55.56	2.19	55.56	2.19	55.56

TABLE IV—Continued.

RACE.	No.	Sex.	ANTERO-POSTERIOR DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
ALEUTIAN ISLANDER	1	F	2.13	53.95	2.13	53.95	2.13	53.95
GUANCHE	1	F	1.63	41.28	1.63	41.28	1.63	41.28
PEGU, Burmah	1	F	1.88	47.62	1.88	47.62	1.88	47.62
MAURITIAN DWARF	1	?	2.13	53.95	2.13	53.95	2.13	53.98
UNKNOWN	3	M	1.81	46.04	2.06	52.32	1.95	49.60
	5	F	1.69	42.86	2.00	50.80	1.91	48.41
FIJI ISLANDERS	1	M	2.28	57.92	2.28	57.92	2.28	57.92
	1	F	2.09	53.19	2.09	53.19	2.09	53.19
BAVARIAN	1	M	2.13	53.95	2.13	53.95	2.13	53.95
	1	F	1.81	46.04	1.81	46.04	1.81	46.04
NEW ZEALANDERS	3	M	1.56	39.69	2.13	53.95	1.92	48.76
	3	F	1.75	44.46	2.03	51.56	1.93	49.00
AUSTRIANS	3	M	1.94	49.25	2.01	51.05	1.96	49.78
	3	F	1.75	44.46	2.13	53.95	1.94	49.25
CHINESE	1	M	2.09	53.19	2.09	53.19	2.09	53.19
	1	F	1.94	49.25	1.94	49.25	1.94	49.25
JAPANESE	1	M	1.91	48.23	1.91	48.23	1.91	48.23
	1	F	2.06	52.32	2.06	52.32	2.06	52.32
AUSTRALIANS	1	M	2.25	57.13	2.25	57.13	2.25	57.13
	2	F	1.75	44.46	2.28	57.92	2.01	51.05
SAMOAN ISLANDER	1	M	1.94	49.25	1.94	49.25	1.94	49.25
GALLO-ROMAN	1	M	2.00	50.80	2.00	50.80	2.00	50.80
	1	F	1.88	47.62	1.88	47.62	1.88	47.62
ROMANO-BRITISH	1	F	1.84	46.74	1.84	46.74	1.84	46.74
WHITES	3	M	1.75	44.46	2.13	53.95	1.98	50.29
	1	F	2.19	55.56	2.19	55.56	2.19	55.56
EGYPTIAN	1	F	1.81	46.04	1.81	46.04	1.81	46.04
AMERICAN NEGROES	3	M	2.03	51.56	2.19	55.56	2.13	53.95
	3	F	2.06	52.32	2.13	53.95	2.08	52.73
MARSHPEE INDIANS	34	...	1.75	44.46	2.07	52.29	1.98	50.27
RECENT, Illinois	712	....	1.56	39.69	2.19	55.56	1.84	46.74
Total	2015		1.66	45.84	2.04	51.42	1.78	49.33

TABLE V.

Race.	No.	Sex.	Height of Vault. Minimum. In.	Minimum. Mm.	Maximum. In.	Maximum. Mm.	Average. In.	Average. Mm.
Ancient and Modern Romans; Lake Dwellers; French prior to nineteenth century	34	M	.25	6.35	.69	17.52	.53	13.46
	30	F	.31	7.65	.63	16.00	.48	12.19
Sandwich Islanders	25	M	.37	9.39	.75	19.05	.55	13.97
	26	F	.31	7.62	.69	17.52	.52	13.21
Ancient Peruvians	137	M	.25	6.35	.81	20.57	.57	14.47
	124	F	.37	9.39	.75	19.05	.57	14.47
	17	?	.44	11.17	.63	16.00	.49	12.45
Ancient Californians	34	M	.44	11.17	.69	17.52	.55	13.97
	38	F	.44	11.17	.75	19.05	.55	13.97
Californian Indians	29	M	.41	10.45	.69	17.52	.54	13.71
	26	F	.44	11.17	.69	17.52	.52	13.21
Mound Builders	56	M	.44	11.17	.72	18.29	.55	13.97
	47	F	.44	11.17	.69	17.52	.56	14.23
	7	?	.41	10.45	.66	16.78	.51	12.95
Stone Grave People—Cumberland Valley	87	M	.41	10.45	.88	22.35	.60	15.02
	89	F	.37	9.39	.75	19.05	.55	13.97
	11	?	.37	9.39	.56	14.23	.50	12.70
Indians	17	M	.44	11.17	.69	17.52	.57	14.47
	11	F	.41	10.45	.59	14.98	.47	11.93
	3	?	.50	12.70	.63	16.00	.56	14.23
Negro—Rio de Favino	1	....	.....	.....	.....	.....	.50	12.70
Flat Heads from Oregon, Washington, Gulf of Georgia, Peru	3	M	.50	12.70	.75	19.05	.65	16.51
	2	F	.50	12.70	.56	14.23	.53	13.46
	1	?	.50	12.70	.50	12.70	.50	12.70
From San Lorenzo Cave, Mexico	4	M	.50	12.70	.69	17.52	.60	15.02
	3	F	.44	11.17	.66	16.78	.54	13.71
From Caves in Tennessee, Kentucky, Mexico	3	M	.53	13.46	.53	13.46	.53	13.46
	....	?	.....	.....	.....	.....	.....	.....
	3	F	.47	11.93	.53	13.46	.51	12.95
Esquimaux from Labrador, Norton Sound	....	?	.....	.....	.....	.....	.....	.....
	2	M	.50	12.70	.56	14.23	.53	13.46
Hindoos	1	M	.50	12.70	.50	12.70	.50	12.70
	....	?	.....	.....	.....	.....	.....	.....
	3	F	.44	11.17	.69	17.52	.60	15.02
Herney Islanders	3	M	.44	11.17	.63	16.00	.57	14.47
	....	?	.....	.....	.....	.....	.....	.....
Hawaiian Islander	1	M	.63	16.00	.63	16.00	.63	16.00
Negroes, African Negroes	2	M	.53	13.46	.63	16.00	.57	14.47
	....	?	.....	.....	.....	.....	.....	.....
	1	F	.44	11.17	.44	11.17	.44	11.17
Zulus, South Africa	1	F	.50	12.70	.50	12.70	.50	12.70
	1	M	.75	19.05	.75	19.05	.75	19.05
Probably Africans	2	F	.44	11.17	.50	12.70	.47	11.93
Negro Criminal (Giles)	1	M	.50	12.70	.50	12.70	.50	12.70
Aleutian Islander	1	F	.31	7.62	.31	7.62	.31	7.62

TABLE V—Continued.

RACE.	No.	Sex.	HEIGHT OF VAULT.					
			Minimum.		Maximum.		Average.	
			In.	Mm.	In.	Mm.	In.	Mm.
Guanche	1	F	.44	11.17	.44	11.17	.44	11.17
Pegu, Burmah	1	F	.50	12.70	.50	12.70	.50	12.70
Mauritian Dwarf	1	?	.50	12.70	.50	12.70	.50	12.70
Unknown	3	M	.53	13.46	.56	14 23	.54	13.71
	5	F	.53	13.46	.69	17.52	.57	14.47
Marshpee Indians	46	....	.41	10.45	.63	16.00	.52	13.22
Total	954		.44	11.36	.62	15.48	.51	13.57

[The averages in Table I are maximum and minimum figures alone, while those in the other tables are deduced from the total of all the measurements.]

TABLE VI.

No.	Lateral.	Antero-Posterior.	Height of Vault.
1	1.31 In. = 33.22 Mm.	2 In. = 50.80 Mm.	0.37 In. = 9.42 Mm.
2	1.25 " = 31.75 "	2.12 " = 53.84 "	0.62 " = 15.74 "
3	1.37 " = 34.79 "	2 " = 50.80 "	0.43 " = 10.92 "
4	1.56 " = 39.51 "	2.37 " = 60.70 "	0.75 " = 19.05 "
5	1.62 " = 41.12 "	2.25 " = 57.15 "	0.50 " = 15.24 "
6	1.25 " = 31.75 "	2.12 " = 53.84 "	0.31 " = 7.87 "

TABLE VII.

THIRTY-FOUR EUROPEAN SKULLS.

	Length in Millimeters.	Width in Millimeters.	Height in Millimeters.
Maximum	58	42	15
Minimum	40	31	5.5
Average	49	*35	*9

TABLE VIII.

THIRTY-TWO MIXED SKULLS.

	Length in Millimeters.	Width in Millimeters.	Height in Millimeters.
Maximum	65	40	18
Minimum	43	29	6
Average	54.9	*35	*12

*Taken at second bicuspid.

TABLE IX.

Examination of criminal youth at Elmira, N. Y. (1,018), and Pontiac, Ill. (414).

	No.	Jaws. V-Shaped.	Jaws. Partial V.	Jaws. Semi V.	Jaws. Saddle.	Jaws. Partial Saddle.	Jaws. Semi Saddle.	Jaws. Normal.	Teeth. Regular.	Teeth. Irregular.	Teeth. Tubercles. Present.	Teeth. Tubercles. Absent.	Alveolar Process. Normal.	Alveolar Process. Abnormal. Hypertrophy.	Alveolar Process. Abnormal. Atrophy.
Illinois State Reformatory.	414	75	71	3	66	63	16	171	123	342	13	452	371	93	1
New York State Reformatory.	1,018	381	49	1	157	26	...	422	220	821	26	1,015	968	73	...

TABLE X.

The following table shows the different deformities of the jaws and teeth found among 477 criminals at Joliet, Ill.:

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Semi V.	Saddle-Shaped Arch.	Small Jaw.	Partial Saddle.	Semi Saddle.
468	M	163	66	17	5	70	13	79	19	59	30	92	24
9	F	9	9	....	....	.....	.....	.....	.....	.....	.....	.....	....
Per cent.		36.06	15.72	3.56	1.04	14.67	2.70	16.56	3.98	12.36	6.29	19.28	5.03

TABLE XI.

JAWS OF PROSTITUTES.

	Width Outside 1st Molar.	Width Outside 2d Bicuspid.	Width Between 2d Bicuspid.	Height of Vault.	V-Shape.	Partial V-Shape.	Semi V-Shape.	Saddle.	Partial Saddle.	Semi Saddle.
Average..	2.00	1.69	1.06	49	......	......	.....	......	....	....
Per cent..	......	......	......	......	10	17	7	27	10	10

TABLE XII.

The following table shows the results of the examination of the jaws and teeth of 700 insane cases of patients in Chicago, Ill. (Cook County), Insane Hospital.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
430	M	347	10	4	2	18	12	29	3	5
270	F	139	- 8	6	4	26	14	18	9	2
700		486	18	10	6	44	26	47	12	7

TABLE XIII.

In this table we have the results of measurements of over 600 inmates of the Illinois Eastern Hospital for the Insane at Kankakee, classified according to the general type of their disorder:

	No.	Sex.	Measurement of Jaw Outside of 1st Permanent Molar, in Inches.			Measurement of Jaw Outside of 2d Bicuspid, in Inches.			Width of Vault Between 2d Bicuspids in Inches.			Height of Vault, in Inches.			Deformities.						
			Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	V.	P. V.	S. V.	S.	P. S.	S. S.	%
Acute Mania	18	M	2.50	2.00	2.24	2.12	1.75	1.90	1.50	1.00	1.23	.62	.37	.55	1	2	2	3	2	1	61
	16	F	2.25	1.87	2.07	2.00	1.50	1.79	1.25	.87	1.07	.75	.12	.52	2	1	....	4	3	2	75
Melancholia	67	M	2.62	1.12	2.23	2.50	1.00	1.90	1.62	.75	1.22	.75	.37	.55	9	15	5	7	10	1	65
	66	F	2.75	1.50	2.08	2.00	1.37	1.77	1.37	.87	1.06	.62	.25	.52	2	8	5	15	12	16	86
Paranoiacs	63	M	2.50	1.87	2.17	2.12	1.50	1.94	1.50	1.00	1.25	.87	.18	.58	14	12	....	10	18	5	71
	24	F	2.50	1.87	2.13	2.00	1.50	1.77	1.75	.87	1.11	.75	.37	.50	1	3	2	10	7	4	87
Epileptics	40	M	2.50	2.00	2.24	2.12	1.37	1.87	1.87	1.12	1.26	.75	.37	.54	6	9	3	3	5	3	72
	15	F	2.25	1.87	2.07	2.00	1.75	1.79	1.12	.87	1.03	.75	.37	.54	1	3	....	5	3	....	80
General Paresis	19	M	2.50	2.00	2.22	2.12	1.50	1.91	1.87	1.00	1.26	.62	.37	.52	3	4	2	2	1	2	73
	1	F	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....
Alcoholic Insanity	9	M	2.50	2.12	2.30	2.00	1.75	1.94	1.37	1.00	1.26	.75	.25	.52	1	1	....	....	....	2	44
	....	F	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Puerperal Insanity	....	M	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	5	F	2.37	1.87	2.09	2.50	1.50	1.87	1.37	.75	1.09	.75	.25	.52	....	2	....	....	1	....	60
Idiocy	2	M	2.25	2.00	2.12	2.12	2.00	2.06	1.75	1.75	1.75	.62	.62	.62	1	....	....	....	....	....	50
	4	F	2.25	1.75	2.00	2.00	1.25	1.62	1.12	.75	.99	.75	.37	.50	1	1	....	1	....	....	75
Degenerative Insanity—Adolescent, Hysterical, Chronic, etc.	9	M	2.50	2.00	2.28	2.12	1.75	1.93	1.50	1.00	1.08	.75	.37	.56	....	2	1	....	3	....	67
	6	F	2.25	2.00	2.10	1.75	1.75	1.75	1.75	1.75	1.75	.62	.50	.52	1	1	....	1	2	....	83
*Terminal Dementia	147	M	2.50	1.75	2.09	2.25	1.12	1.87	1.75	.87	1.19	1.00	.25	.54	18	18	7	15	21	14	61
	102	F	2.87	1.12	2.12	2.12	1.37	1.79	1.75	.75	1.11	1.00	.37	.52	7	25	2	23	17	11	83
Total	613		2.46	1.63	2.09	2.10	1.51	1.85	1.54	.99	1.21	.74	.33	.53							

* Under "Terminal Dementia" are included all those cases of secondary insanity of long duration, usually called dements, and chronic maniacs. They include, necessarily, a very large proportion of degenerative and hereditary cases; but, their history being lacking, just how much cannot be stated. It is probably not under 60 per cent., and may exceed 75 per cent

The examinations were made by able dentists and myself in the following named institutions:

Asylum for Idiots of the State of New York, at Syracuse; Massachusetts School for Feeble-minded, at South Boston; Illinois Asylum for Feeble-minded Children, at Lincoln; Asylum for Idiots, Randall's Island, N. Y.; Minnesota Training-school for Idiots and Imbeciles, Faribault; Kansas State Asylum for Idiots and Imbeciles, South Winfield; Cook County Insane Asylum, Dunning, Ill.; Pennsylvania Institution for Feeble-minded Children, at Elwyn.

The following tables show the total number of irregularities in each grade and sex:

TABLE XIV.

DEFORMITIES IN THE JAWS.*

No.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
1,977	1,095	152	92	159	318	129	236	207	71
Per cent.	55.3	7.6	4.6	7.9	16	6.5	11.9	10.4	3.5

* All tables show irregularities that are the result of small jaws.

TABLE XV.

Stature and weight, general population and inmates of the Earlswood, Royal Albert, and Larbert Asylums. (Shuttleworth.)

Age Last Birth-day.	HEIGHT, INCHES.				WEIGHT, POUNDS.			
	GENERAL POPULATION.		IDIOTS AND IMBECILES.		GENERAL POPULATION.		IDIOTS AND IMBECILES.	
	M.	F.	M.	F.	M.	F.	M.	F.
5	41.00	40.55	40.00	39.50	.....	39.20	39.00	37.50
6	43.00	42.88	42.25	41.25	.....	41.70	43.00	41.00
7	45.00	44.45	44.00	43.25	.....	47.50	46.50	45.00
8	47.00	46.60	45.75	45.25	55.00	52.10	50.50	49.00
9	49.00	48.73	47.50	47.50	60.00	55.50	55.50	53.00
10	51.00	51.05	49.00	49.00	65.00	62.90	59.00	59.00
11	53.00	53.10	51.00	51.00	70.00	68 10	64.50	66.00
12	55.00	55.66	52.50	53.00	77.50	76.40	70.50	72.00
13	57.50	57.77	54.75	55.00	85.00	87.20	77.00	80.00
14	60.00	59.80	56.50	56.50	92.50	96.70	85.50	88.00
15	62.20	60.93	59.25	58.00	102.50	106.30	94.50	95.00
16	64.00	61.75	60.75	59.00	117.50	113.10	103.00	102.00
17	65.50	62.52	62.50	59.25	135.00	115.50	110.00	106.00
18	66.50	62.44	63.25	.....	142.50	121.10	116.00	108.00
19	67.00	62.75	63.25	.....	143.70	123.80	120.50	108.50
20	67.25	62.98	64.00	59.50	145.00	123.40	121.50	108.50
21	67.50	63.03	64.25	.....	146.20	121.80	122.00	.....

TABLE XV—Continued.

Age Last Birthday.	HEIGHT, INCHES. General Population M.	F.	Idiots and Imbeciles. M.	F.	WEIGHT, POUNDS. General Population. M.	F.	Idiots and Imbeciles. M.	F.
22	.....	62.87	64.50	.....	147.50	123.40	122.50	.....
23	.....	63.01	.....	.....	148.70	124.10	......	......
24	.....	62.70	.....	.....	150.00	120.80	......	......
25–30	67.75	62.02	64.75	59.75	151.20	120.00	123.00	109.00
30–40	.....	.....	.....	.....	152.50	120.80	......	......
40–50	.....	61.15	.....	.....	155.00	118.60	......	......
50–60	68.00	.....	.....	.....	157.50	104.00	......	......

TABLE XVI.

DEFORMITIES OF JAWS OF INEBRIATES.*

No.	Normal.	Large Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Semi V-Shaped Arch.	Saddle Arch.	Partial Saddle Arch.	Semi Saddle Arch.
514	25.4	6.4	59.5	1.5	24.4	0.3	9.3	13.2	7.7

*The examination of inebriates was made in The Keeley Institute, Dwight, Ill.; The Inebriates' Home, Ft. Hamilton, N. S.; Washington Home, Chicago; Washington Home, Boston, and Dr. Crother's Institute, Hartford, Conn.

TABLE XVII.

DEFORMITIES IN JAWS OF THE BLIND.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Arch.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
107	M	53	8	9	10	20	4	3	6	7
100	F	52	8	7	5	18	3	6	5	3
207	......	105	16	16	15	38	7	9	11	10
Per cent....		50.7	7.7	7.7	7.2	18.3	3.3	4.3	5.3	4.8

One case cleft palate.

In twenty-seven examinations of congenitally blind patients, all possessed either deformities of the head, face, jaws or teeth.

TABLE XVIII.

TOTAL DEFORMITIES IN THE JAWS OF THE DEAF AND DUMB.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
1,111	M	538	197	41	116	241	91	115	108	51
824	F	363	108	51	89	177	78	77	95	62
1,935	......	901	305	92	205	418	169	192	203	113
Per cent....		45.3	15.7	4.7	10.5	21.7	8.7	9.9	10.4	5.8

Two cases cleft palate.

TABLE XIX.

NEUROSES OF DEVELOPMENT OF JAWS OF SEEMINGLY NORMAL INDIVIDUALS.

That the deformities of the jaws of the neurotics and degenerates as found in our asylums may be compared with those whom we meet in every-day life, the author examined the mouths of 1,000 school children over twelve years of age and 1,000 adults, patients and friends, with the following results:

DEFORMITIES IN CHILDREN'S JAWS.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
396	M	303	11	3	5	26	5	18	12	13
604	F	463	8	4	2	30	6	43	21	17
1,000	......	766	19	7	7	56	11	61	33	30
Per cent....		76	1.9	.7	.7	5.6	1.1	6.1	3.3	3.0

DEFORMITIES IN ADULT JAWS.

No.	Sex.	Normal.	Large Jaw.	Height of Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Semi V-Shaped Arch.	Saddle Arch.	Partial Saddle.	Semi Saddle.
284	M	211	9	48	16	16	10	14	27	9
716	F	403	23	62	19	56	8	29	24	25
1,000	......	614	32	110	35	72	18	43	51	34
Per cent....		61	3.2	11.0	3.5	7.2	1.8	4.3	5.1	3.4

TABLE XX.

BRACHYCEPHALIC—WHITE.

No.	Index.	Width Outside 1st Molar.		Width Outside 2d Bicuspid.		Width Between 2d Bicuspids.		Antero-Posterior.		Height of Vault.		Temperament.
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	
1	84	2.37	60.19	2.12	53.84	1.25	31.75	1.87	47.49	0.44	11.17	Nervo-sanguine.
2	84	2.12	53.84	1.87	47.49	1.25	31.75	2.12	53.84	0.50	12.70	Nervo-sanguine.
3	84	2.62	66.53	2.37	60.19	1.37	34.77	2.37	60.19	0.50	12.70	Nervo-sanguine.
4	84	2.12	53.84	1.87	47.49	1.25	31.75	....	.....	0.56	14.22	Nervo-bilious.
5	84	2.37	60.19	1.87	47.49	1.25	31.75	2.12	53.84	0.62	15.74	Lympho-sanguine.
6	84	2.12	53.84	1.75	44.45	1.00	25.40	2.25	57.15	0.62	15.74	Sanguino-bilious.
7	81	2.37	60.19	2.12	53.84	1.37	34.77	2.18	55.37	0.50	12.70	Nervo-sanguine.
8	81	2.00	50.80	1.87	47.49	1.31	33.27	1.87	47.46	0.56	14.22	Nervo-bilious.
9	81	2.12	53.84	1.87	47.49	1.06	26.92	....	.....	0.37	9.39	Nervous.
10	82	2.00	50.80	1.75	44.45	1.00	25.40	2.50	63.50	0.56	14.22	Nervous.
11	82	2.00	50.80	1.87	47.49	1.06	26.92	2.25	57.15	0.62	15.74	Sanguine.
12	82	2.25	57.15	2.00	50.80	1.12	28.70	2.12	53.84	0.68	17.27	Sanguine.

TABLE XXI.

MESOCEPHALIC—WHITE.

No.	Index.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Between 2d Bicuspids.		Antero-Posterior.		Height of Vault.		Temperament.
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	
1	79	2.25	57.15	2.00	50.80	1.18	29.97	2.00	50.80	0.56	14.22	Sanguine.
2	79	2.25	57.15	2.00	50.80	1.25	31.75	....	.....	0.56	14.22	Nervo-bilious.
3	79	2.00	50.80	1.62	41.15	1.00	25.40	....	.....	0.56	14.22	Sanguine.
4	79	2.50	63.50	2.25	57.15	1.37	34.79	2.25	57.15	0.50	12.70	Sanguine.
5	78	2.12	53.84	1.75	44.45	1.86	26.92	....	.....	0.68	17.27	Nervous.
6	78	2.37	60.20	2.12	53.84	1.37	34.79	2.25	57.15	0.56	14.22	Nervo-sanguine.
7	77	2.25	57.15	2.00	50.80	1.18	29.97	....	.....	0.56	14.22	Nervo-bilious.
8	77	2.25	57.15	2.00	50.80	1.00	25.40	2.25	57.15	0.44	11.17	Nervous.
9	76	2.06	52.32	1.75	44.45	1.00	25.40	...	.....	0.44	11.17	Lymphatic.
10	76	2.37	60.80	2.12	53.84	1.25	31.75	2.37	60.20	0.56	14.22	Nervo-bilious.
11	75	2.00	50.80	1.75	44.45	1.00	25.40	2.00	50.80	0.31	7.87	Neurotic.
12	75	2.18	55.37	2.00	50.80	1.25	31.75	....	.....	0.50	12.70	Neurotic.

TABLE XXII.

DOLICHOCEPHALIC—WHITE.

No.	Index.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Between 2d Bicuspids.		Antero-Posterior.		Height of Vault.		Temperament.
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	
1	72	2.25	57.15	2.12	53.84	1.50	38.10	2.12	53.84	0.75	19.05	Nervo-bilious.
2	72	2.25	57.15	2.00	50.80	1.25	31.75	2.12	53.84	0.62	15.74	Bilious.
3	72	2.00	50.80	1.87	47.49	1.25	31.75	2.18	55.37	0.75	19.05	Nervo-lymphatic.
4	72	2.37	60.19	2.00	50.80	1.44	36.54	2.31	58.67	0.75	19.05	Sanguine.
5	71	2.06	52.32	1.87	47.49	1.25	31.75	....	.....	0.81	20.75	Sanguine.
6	66	2.25	57.15	2.00	50.80	1.31	33.27	....	.....	0.75	19.05	Nervo-bilious.

TABLE XXIII.

BRACHYCEPHALIC—COLORED.

No.	Index.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Between 2d Bicuspids.		Antero-Posterior.		Height of Vault.	
		In.	Mm.	In.	Mm.	In.	Mm.	In	Mm.	In.	Mm.
1	87	2.87	72.90	2.00	50.80	1.31	33.27	2.18	55.37	0.56	14.22
2	87	2.50	63.50	2.25	57.15	1.62	41.15	2.12	53.84	0.50	12.70
3	85	2.37	60.20	2.00	50.80	1.37	34.77	....	.....	0.62	15.74
4	84	2.25	57.15	2.00	50.80	1.31	33.27	2.00	50.80	0.75	19.05
5	84	2.50	63.50	2.12	53.84	2.50	63.50	2.25	57.15	0.50	12.70
6	81	2.50	63.50	2.00	50.80	1.37	34.79	2.25	57.15	0.75	19.05

TABLE XXIV.

MESOCEPHALIC—COLORED.

No.	Index.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Between 2d Bicuspids.		Antero-Posterior.		Height of Vault	
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
1	80	2.50	63.50	2.25	57.15	1.62	41.15	2.31	58.67	0.62	15.74
2	79	2.81	71.37	2.50	63.50	1.62	41.15	2.25	57.15	0.62	15.74
3	79	2.25	57.15	2.00	50.80	1.50	38.10	2.00	50.80	0.62	15.74
4	78	2.50	63.50	2.50	63.50	1.50	38.10	2.37	60.20	0.62	15.74
5	78	2.12	53.84	1.50	38.10	1.31	33.27	2.12	53.84	0.62	15.74
6	75	2.37	60.20	2.00	50.80	1.37	34.79	....	.....	0.50	12.70

TABLE XXV.

DOLICHOCEPHALIC—COLORED.

No.	Index.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Between 2d Bicuspids.		Antero-Posterior.		Height of Vault.	
		In.	Mm.	In.	Mm	In.	Mm.	In.	Mm.	In.	Mm.
1	70	2.12	53.84	1.87	47.49	1.18	29.97	2.18	55.37	0.56	14.22
2	69	2.50	63.50	2.12	53.84	1.50	38.10	2.25	57.15	0.62	15.74
3	67	2.50	63.50	2.18	55.37	1.50	38.10	2.25	57.15	0.62	15.74
4	67	2.25	57.15	2.00	50.80	1.18	29.97	2.25	57.15	0.62	15.74
5	63	2.25	57.15	2.12	53.84	1.50	38.10	2.25	57.15	0.62	15.74
6	60	2.50	63.50	2.25	57.15	1.75	44.45	2.37	60.20	0.68	17.27

TABLE XXVI.

BRACHYCEPHALIC, AVERAGE—WHITE AND COLORED.

Race.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Inside 2d Bicuspids.		Antero-Posterior.		Height of Vault	
	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
White..	2.22	56.38	1.98	50.29	1.19	30.22	2.16	54.86	0.54	13.71
Colored.	2.33	59.18	2.06	52.32	1.53	38.86	2.16	54.86	0.61	15.49

TABLE XXVII.

MESOCEPHALIC, AVERAGE—WHITE AND COLORED.

RACE.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Inside 2d Bicuspids.		Antero-Posterior.		Height of Vault.	
	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
White..	2.21	56.13	1.95	48.53	1.16	29.47	2.18	55.37	0.52	13.20
Colored.	2.42	61.36	2.12	53.84	1.49	37.55	2.16	54.86	0.60	15.24

TABLE XXVIII.

DOLICHOCEPHALIC, AVERAGE—WHITE AND COLORED.

RACE.	Width Outside 1st Molar.		Width Outside 2d Bicuspids.		Width Inside 2d Bicuspids.		Antero-Posterior.		Height of Vault.	
	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
White..	2.19	55.62	1.97	50.03	1.50	38.10	2.18	55.37	0.74	18.79
Colored.	2.35	59.69	2.09	53.08	1.42	36.06	2.26	57.40	0.62	15.74

The following table exhibits the differences in the heights of vaults in normal and defective jaws. The height is taken centrally and vertically from the gingival plane on a transverse line intersecting gingival crests between the second bicuspids and first molars. Fig. 24 shows the instrument used, and the manner of making the measurements.

TABLE XXIX.

NORMAL JAW.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.
.21	1	.40	159	.56	936	.71	149
.25	2	.43	182	.59	218	.75	427
.28	70	.46	69	.62	514	.78	69
.31	171	.50	199	.65	150	.81	75
.34	169	.53	429	.68	568	.84	12
.37	146	...	...	...	...	...	...

Total number of cases, 4,614. Average, .58 of an inch.

TABLE XXX.

SADDLE-SHAPED ARCH.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.
.21	..	.40	..	.56	6	.71	5
.25	..	.43	..	.59	5	.75	5
.28	..	.46	3	.62	4	.78	1
.31	..	.50	5	.65	..	.81	1
.34	..	.53	5	.68	3	.84	..
.37	1	...	..	...	..	...	..

Total number of cases, 44. Average, .60 of an inch.

TABLE XXXI.

V-SHAPED ARCH.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.
.21	..	.40	1	.56	15	.71	1
.25	..	.43	..	.59	4	.75	2
.28	..	.46	3	.62	9	.78	..
.31	2	.50	8	.65	..	.81	1
.34	..	.53	3	.68	5	.84	..
.37	4	...	..	...	..	...	..

Total number of cases, 58. Average, .55 of an inch.

TABLE XXXII.

SEMI-V AND SEMI-SADDLE-SHAPED ARCH.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.
.21	..	.40	..	.59	1	.75	..
.25	1	.43	1	.62	4	.78	1
.28	..	.46	..	.65	2	.81	..
.31	..	.50	3	.68	..	.84	..
.34	..	.53	3	.71	2	...	..
.37	1	.56	5	...	..	...	..

Total number of cases, 24. Average, .56 of an inch.

TABLE XXXIII.

Deformities of the Jaws Among the Degenerates of Europe.

ATHENS PRISON, 452 CONVICTS.

V-shaped arch	0
Saddle-shaped arch	0
Arrest of the lower jaw	Frequent.
Recession of the forehead	Frequent.
Irregular relation of the upper and lower jaw	Very common.
Third molars, upper and lower	Usually present.
Vault	Lower than average.

IDIOTS AND INSANE, GREEK INSANE HOSPITAL IN CONSTANTINOPLE, 332, MALES 166, FEMALES 166.

V-shaped arch	1
Saddle-shaped arch	0
Arrest of the lower jaw	48%
Third molars	Normally developed.

IDIOTS AND INSANE, ARMENIAN INSANE HOSPITAL, CONSTANTINOPLE, 250 INMATES; MALES 175, FEMALES 75.

V-shaped arch	1
Arrest of lower jaw	18%
Third molars	Normal.
Third molars	Many.

IDIOTS AND INSANE, VIENNA INSANE HOSPITAL, 326 INMATES.

V-shaped arch	4
Saddle-shaped arch	1
Third molars	Normal 311.

MOSCOW PRISON, 2,000 INMATES (INFIRMARY, 247).

Contracted jaws	0
Irregularities of the teeth	0
Jaws large and vaults low	All.

MOSCOW REFORM SCHOOL, 112 BOYS.

Partial V-shaped arches	3
Saddle-shaped arches	0

Jaws as a rule large and broad, with low vaults.

MOSCOW INSANE HOSPITAL, 400 PATIENTS, 12 IDIOTS.

Contracted arches	0

Jaws large and broad, with low vaults.

STOCKHOLM INSANE HOSPITAL, 270 PATIENTS.

V-shaped arches	6
Partial V-shaped arches	12
Semi V-shaped arches	4
Saddle-shaped	23
Partial saddle-shaped	4
Excessively developed upper jaws	11
Excessively developed under jaws	3
Hypertrophy of the Alveolar Process	9
Missing third molars	42
Missing laterals	6
Deformities of individual teeth	Numerous.

STOCKHOLM SCHOOL OF IDIOCY, 120 INMATES.

	80 Boys.	40 Girls.
Normal jaws	14	15
V-shaped	12	1
Partial V-shaped	10	5
Semi V-shaped	4	5
Saddle-shaped	8	8
Partial saddle-shaped	1	0
Semi saddle-shaped	2	1
Hypertrophy of the Alveolar Process	32	14
Macrocephalic	12	6
Microcephalic	5	4

One boy of thirteen, able to take care of himself, had a head 32 inches in circumference.

HAMBURG PRISON, 1,800 INMATES.

Large, well developed jaws	The rule.
Asymmetry in development	Frequent.

HAMBURG SCHOOL OF IDIOCY, 600 INMATES.

	396 Boys.	204 Girls.
Normal jaws	62	28
V-shaped	12	4
Partial V-shaped	16	7
Semi V-shaped	8	3
Saddle-shaped	4	1
Partial saddle	3	1
Semi saddle	2	3
Hypertrophy of the Alveolar Process	46	25
Macrocephalic	3	5
Microcephalic	4	2

One boy of thirteen had a lower jaw excessively developed one and one-half inches beyond the normal upper.

AMSTERDAM INSANE HOSPITAL, 1,330 INMATES.

Contracted arches	0
Low vaults	67
Hypertrophy of the Alveolar Process	Frequent.
Missing third molars	0

AMSTERDAM SCHOOL OF IDIOCY, 255 INMATES.

	116 Boys.	139 Girls.
V-shaped	1	1
Partial V-shaped	3	2
Semi V-shaped	1	0
Saddle	1	0
Hypertrophy of the Alveolar Process	0	19

Vaults low and jaws well developed.

PARIS SCHOOL OF IDIOTS, 667 INMATES.

	500 Boys.	167 Girls.
V-shaped	1	1
Partial V-shaped	40	6
Semi V-shaped	2	1
Saddle	2	8
Partial saddle	1	2
Semi saddle	4	1
Hypertrophy of the Alveolar Process	7	4

The vaults were low.

PARIS PRISONS (4), INMATES 2,600.

Deformities of the jaw not obvious.

BROADMORE INSANE HOSPITAL (CRIMINALS).

Marked deformities of the jaw and teeth 80 to 85%.

HANWELL INSANE HOSPITAL, 2,080. INSANE AFTER MATURITY.

Hypertrophy of the Alveolar Process frequent.
Excessive and arrested development of the jaws frequent.
Stigmata of degeneracy the rule.

FLETCHER BEACH IDIOTS' SCHOOL, 13 INMATES.

V-shaped	3
Partial V-shaped	8
Semi V-shaped	1
Hypertrophy of the Alveolar Process	6
Notched and pitted teeth	8
High vaults	13
Laterals missing	4

These patients were too young to decide as to number of third molars.

EARLSWOOD IDIOT SCHOOL, 670 INMATES.

	400 Boys.	270 Girls.
Normal jaws	31	24
V-shaped arch	108	67
Partial V-shaped	69	86
Semi V-shaped	11	24
Saddle-shaped	19	8
Partial saddle-shaped	27	23
Semi saddle	13	1
Marked arrest of upper jaw	104	87
Marked protrusion of upper jaw	64	24
Marked protrusion of lower jaw	11	1
Marked arrest of lower jaw	306	237
Lateral incisors arrested	46	30
Lateral incisors lost	28	16
Third molars lost	180	85
Showed malnutrition of teeth	160	78
Cleft palate	0	1

DARENTH SCHOOL. IDIOT, 1,000 INMATES (CHILDREN).

	640 Boys.	360 Girls.
Normal jaws	150	90
V-shaped jaws	143	118
Partial V-shaped jaws	140	80
Semi V-shaped jaws	105	65
Saddle	35	0
Partial saddle	20	8
Semi saddle	10	20
Marked arrest of upper jaw	450	310
Marked protrusion of upper jaw	150	90
Marked protrusion of lower jaw	23	9
Arrest of lower jaw	600	340
Lateral incisors arrested	68	32
Lateral incisors lost	42	19
Third molars lost	388	111
Hypertrophy of upper jaw	150	90

SHUTTLEWORTH SCHOOL FOR IDIOTS, 12 INMATES.

Normal jaw	1
V-shaped	2
Partial V-shaped	5
Semi V-shaped	1
Partial saddle	2
Semi saddle	1
Hypertrophy of Alveolar Process	4
Notched and pitted teeth	9
High vaults	12
Third molars missing	Patients too young to decide
Laterals missing	5

DARENTH ADULT SCHOOL, 1,050 INMATES.

	450 Males.	600 Females.
Normal jaws	60	40
V-shaped	105	177
Partial V-shaped	93	121
Semi V-shaped	53	79
Saddle	31	0
Partial saddle	5	8
Semi saddle	0	10
Marked arrest of upper jaw	295	436
Marked protrusion of upper jaw	162	209
Marked protrusion of lower jaw	8	17
Arrest of lower jaw	409	580
Lateral incisors arrested	48	72
Lateral incisors lost	37	62
Third molars lost	442	597
Hypertrophy of upper jaw	58	36

Of the children, five hundred and seventy-six boys showed malnutrition in utero; two hundred and eighty-two girls showed malnutrition in utero. Of the adults, three hundred and ninety-six males showed malnutrition in utero; five hundred and seventy-eight females showed malnutrition in utero.

LANGDON DOWN'S IDIOT SCHOOL, 147 INMATES.

	97 Boys.	50 Girls.
Normal jaws	12	5
V-shaped	36	10
Partial V-shaped	20	9
Semi V-shaped	15	12
Saddle	9	7
Partial saddle	13	1
Semi saddle	28	16
Arrest of upper jaw	86	45
Third molars missing	92	47
Lateral incisors missing	16	8
Teeth showing arrest and grooves	46	21
Hypertrophy of the Alveolar Process	19	7

Of the twelve normal arches (males) seven were hypertrophied. Of the five normal dental arches (females) three were hypertrophied.

ANTERO-POSTERIOR AND LATERAL ILLUSTRATIONS OF THE VAULT

PLATE 1.

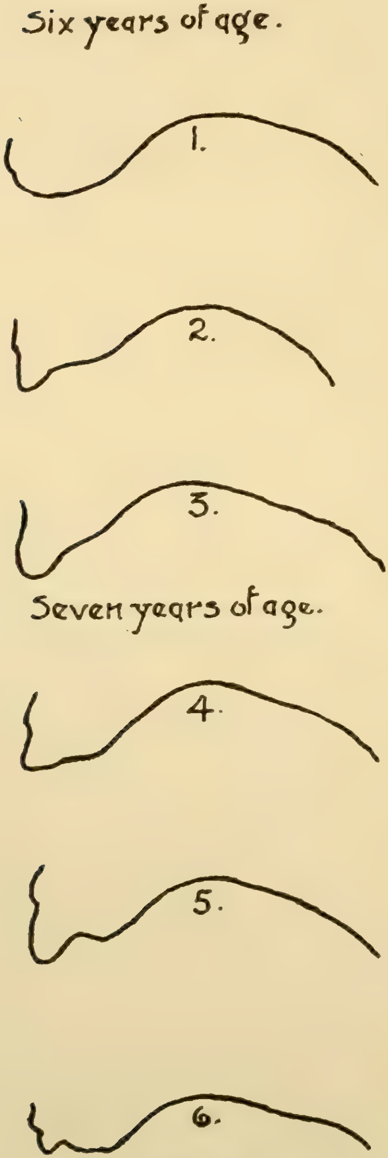


PLATE 2.

Six years of age.

Seven years of age.

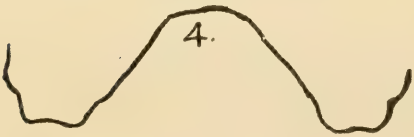


PLATE 3.

Eight years of age.

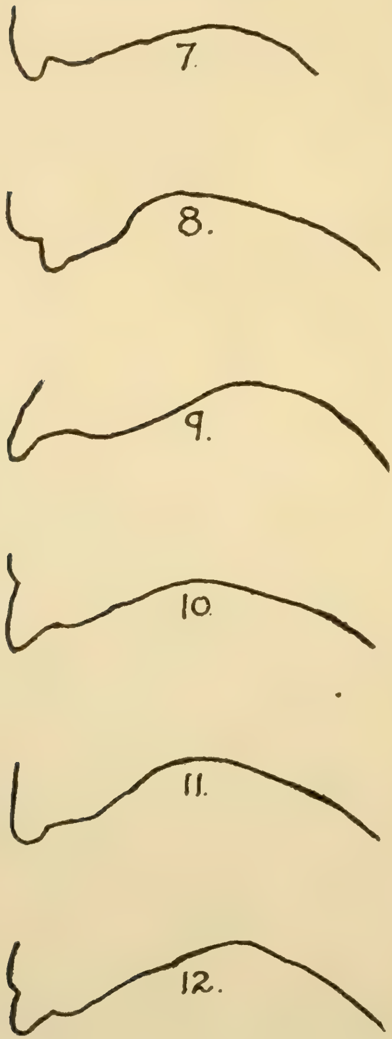


PLATE 4.

Eight years of age.

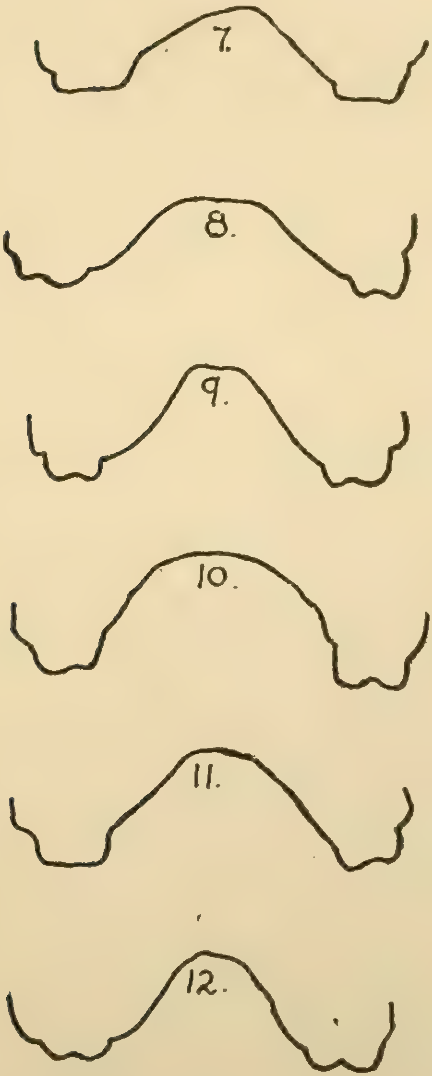


PLATE 5.

Nine years of age.

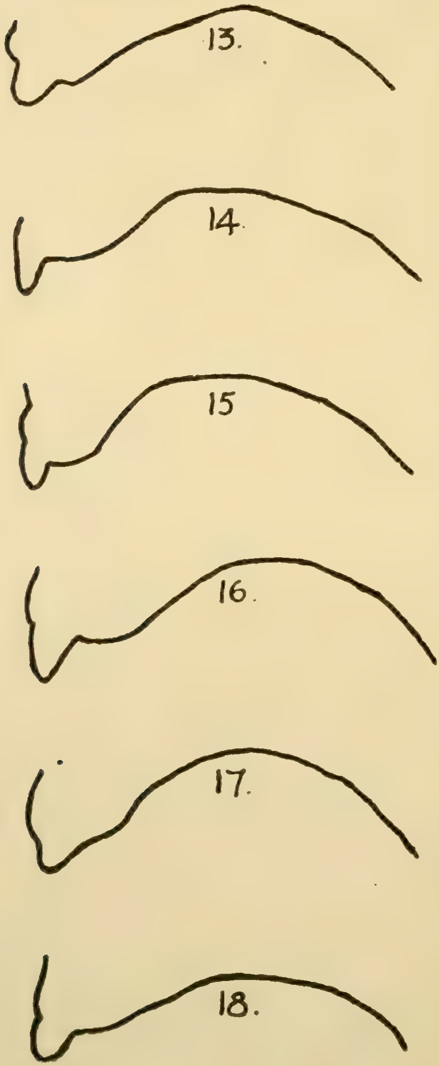


PLATE 6.

Nine years of age.

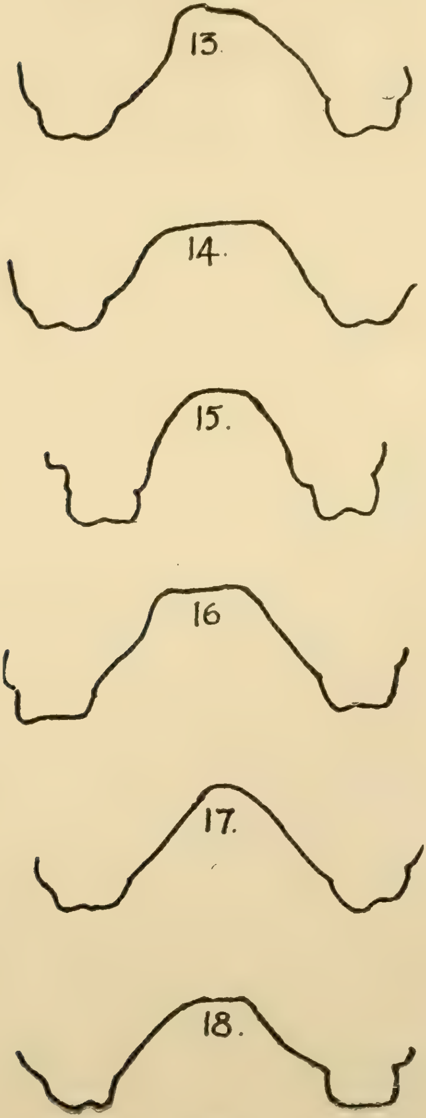


PLATE 7.

Ten years of age.

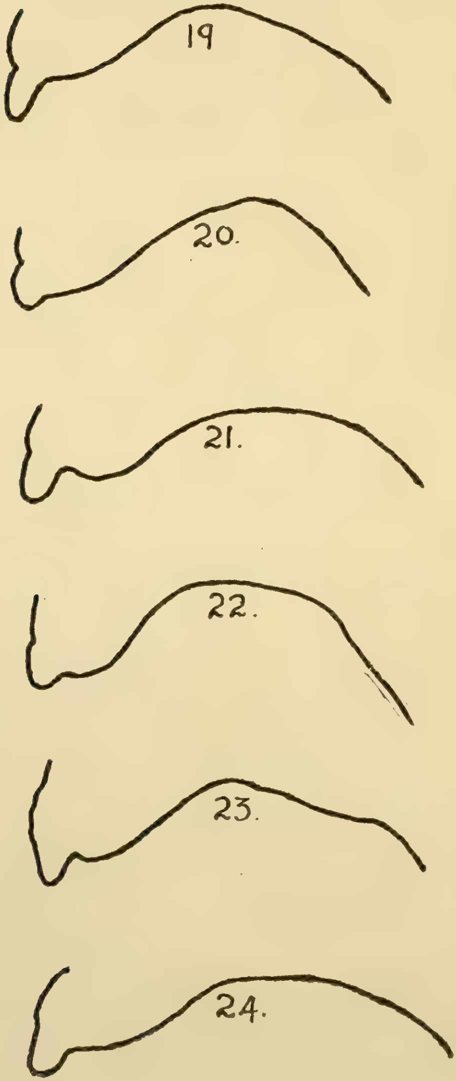


PLATE 8.

Ten years of age.

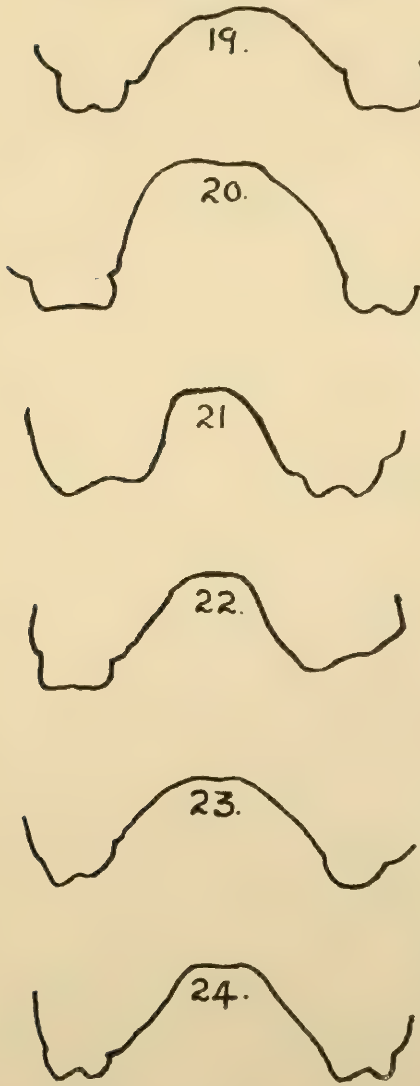


PLATE 9.

Eleven years of age.

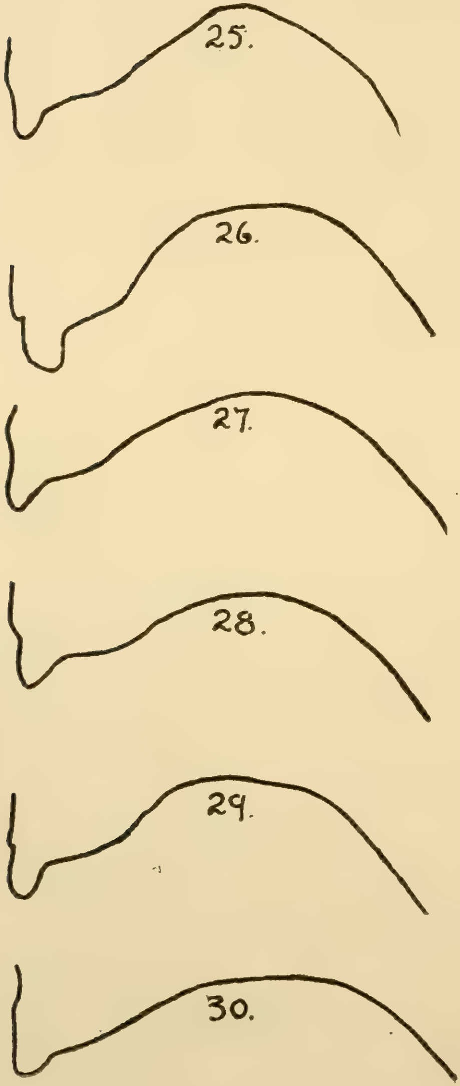


PLATE 10.

Eleven years of age.

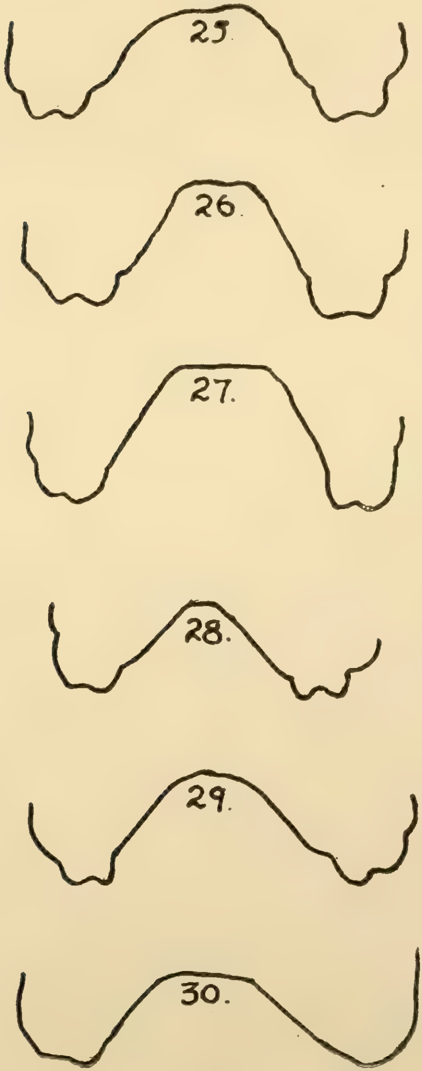


PLATE 11.

Twelve years of age.

PLATE 12.

Twelve years of age.

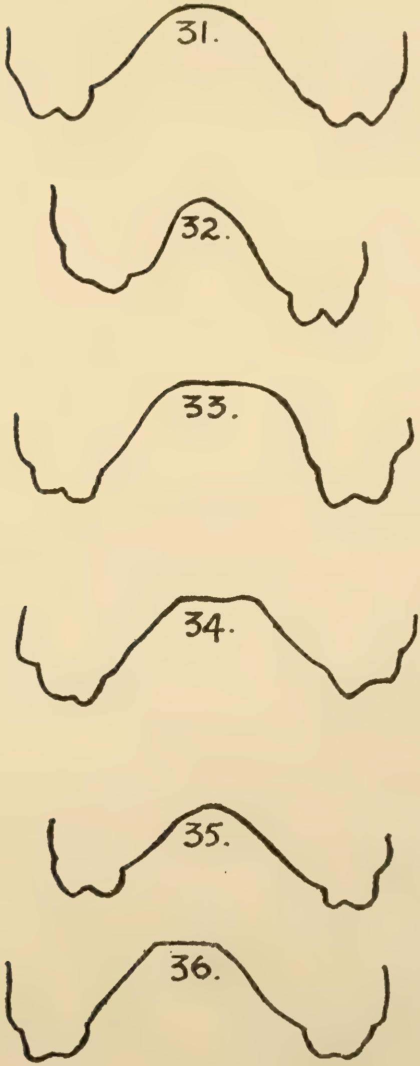


PLATE 13.

Brachycephalic. White.

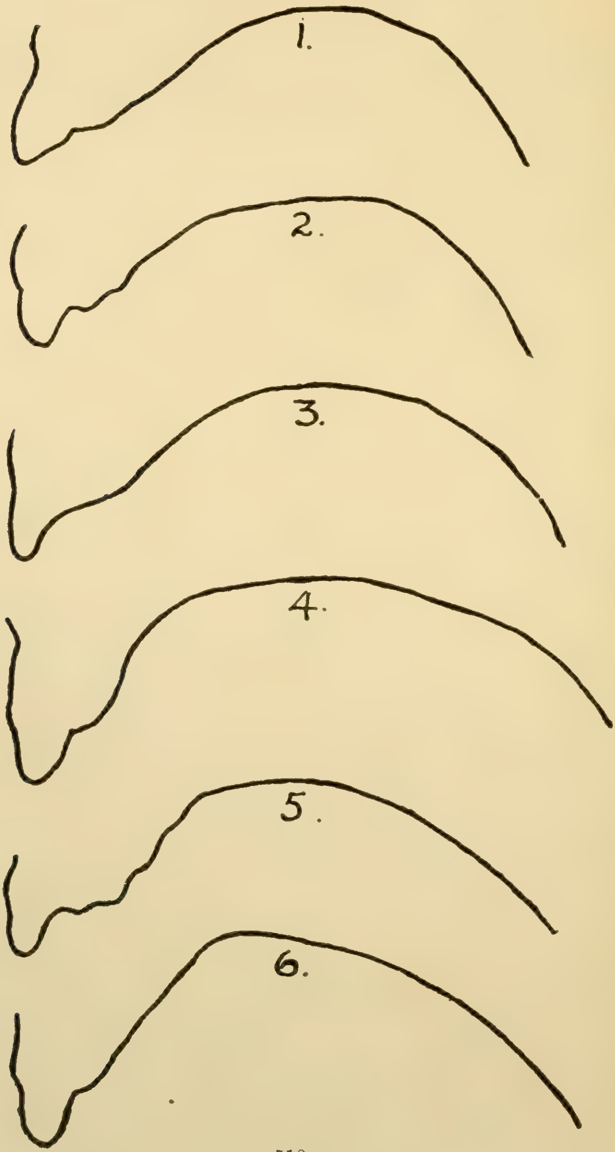


PLATE 14.

Brachycephalic. White.

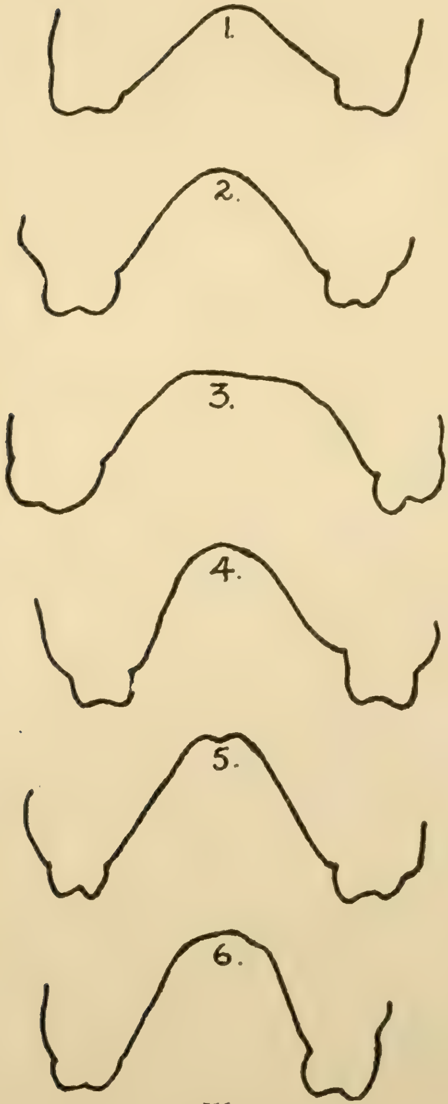


PLATE 15.

Brachycephalic. White.

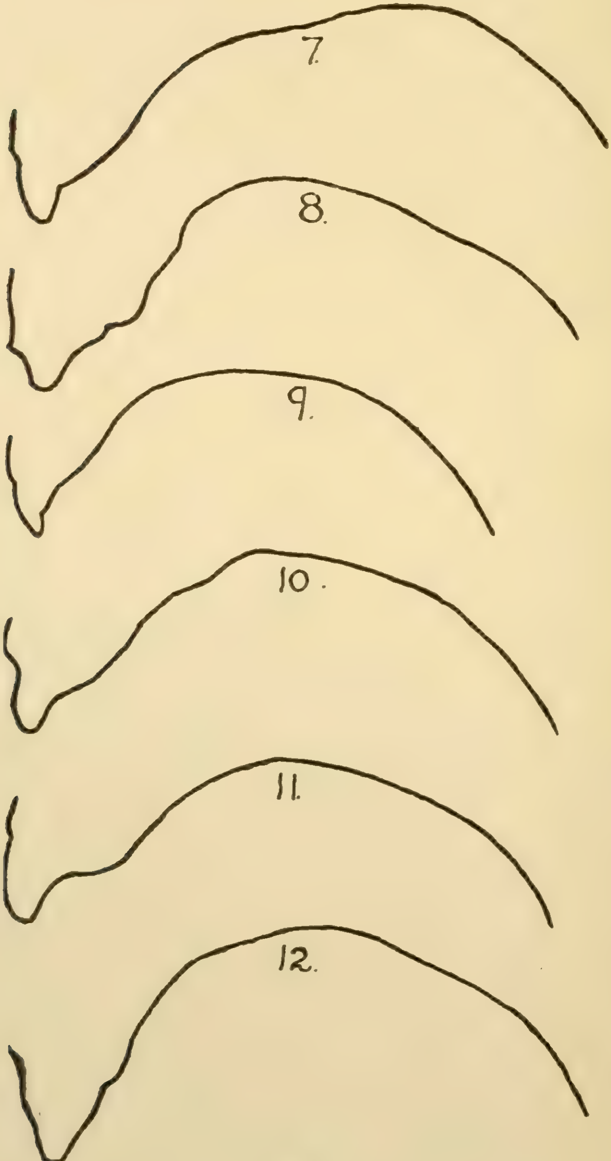


PLATE 16.

Brachycephalic. White.

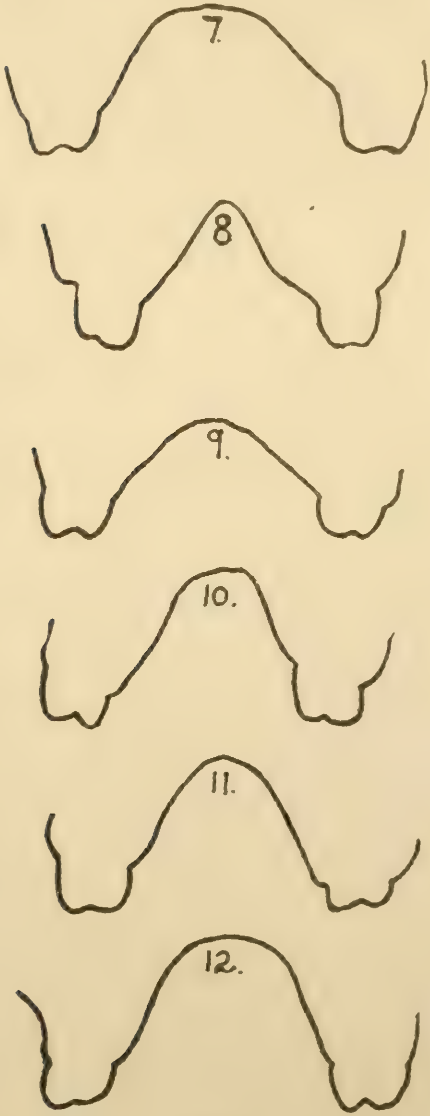


PLATE 17.

Mesocephalic. White.

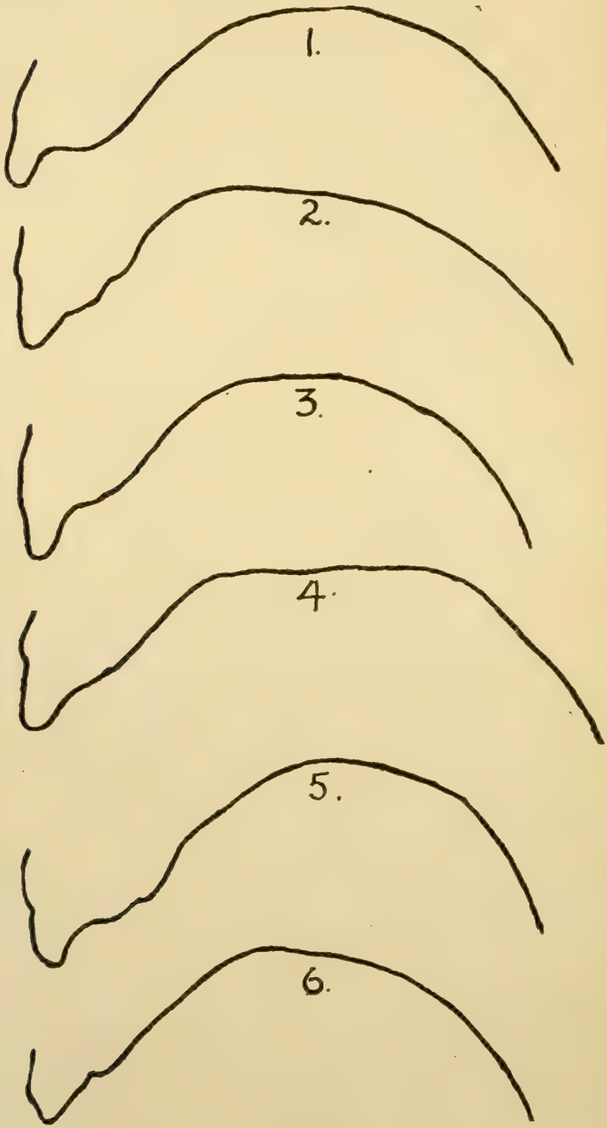


PLATE 18.

Mesocephalic. White.

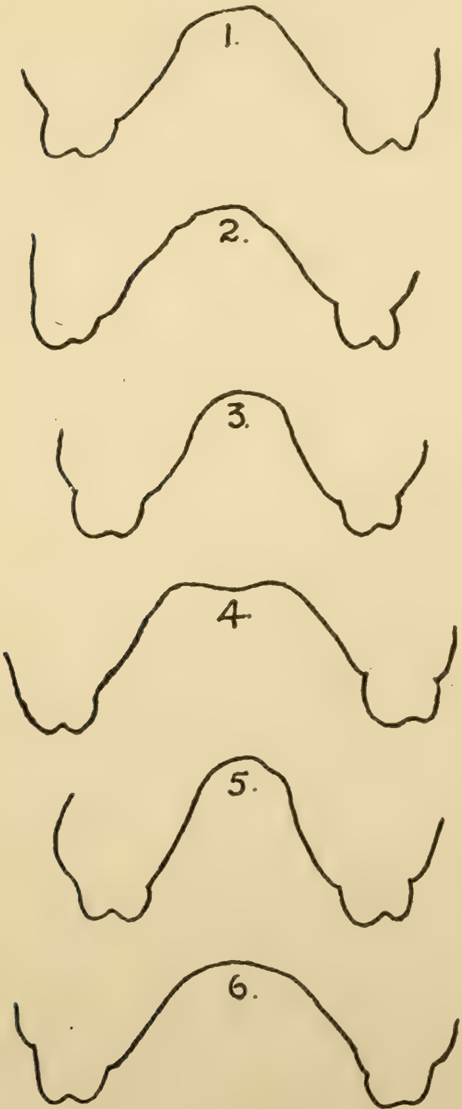


PLATE 19.

Mesocephalic. White.

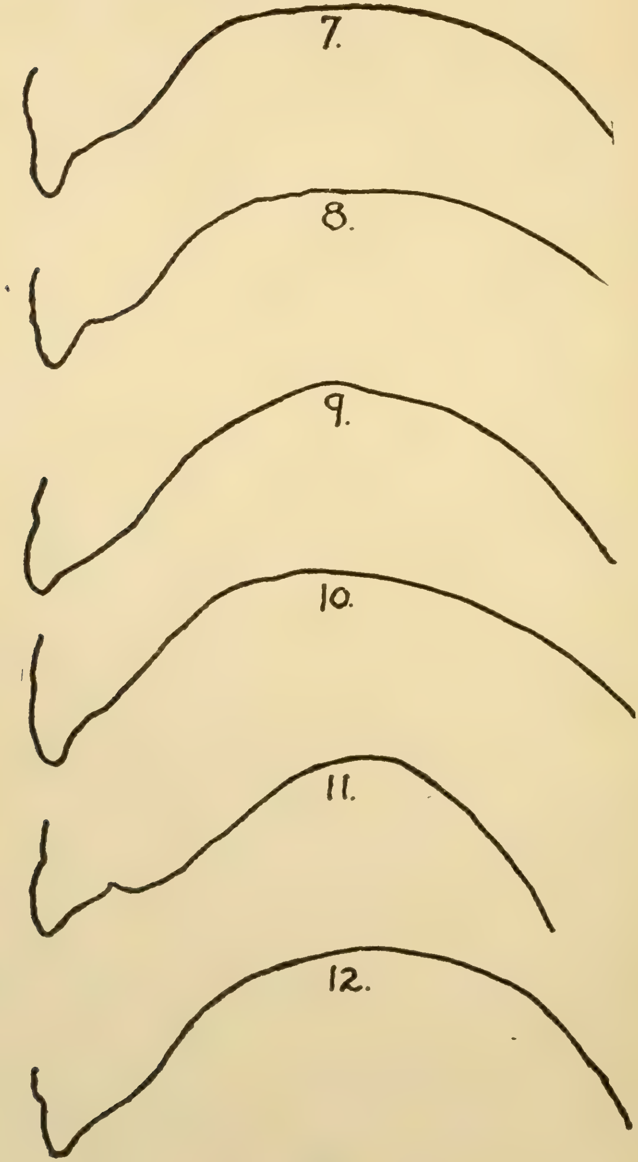


PLATE 20.

Mesocephalic. White.

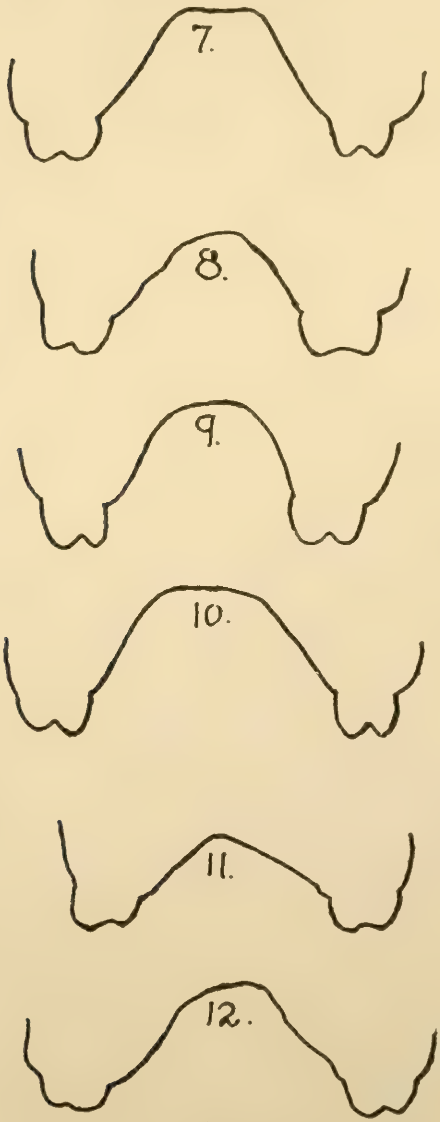


PLATE 21.

Dolichocephalic. White.

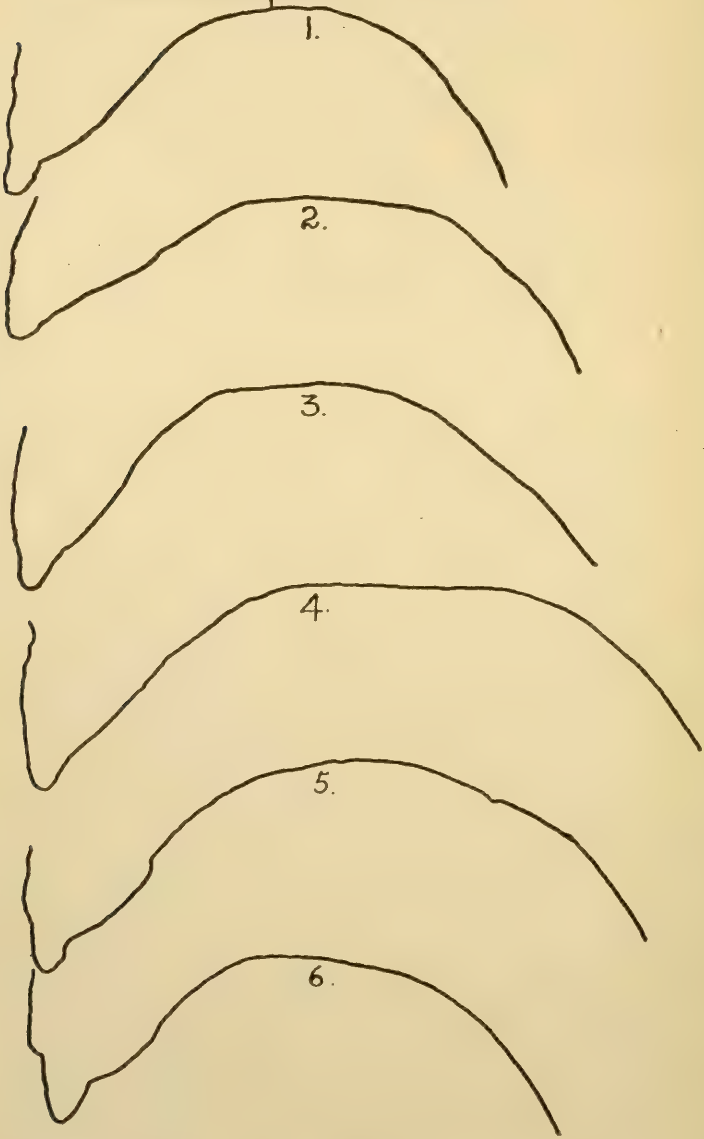


PLATE 22.

Dolichocephalic. White.

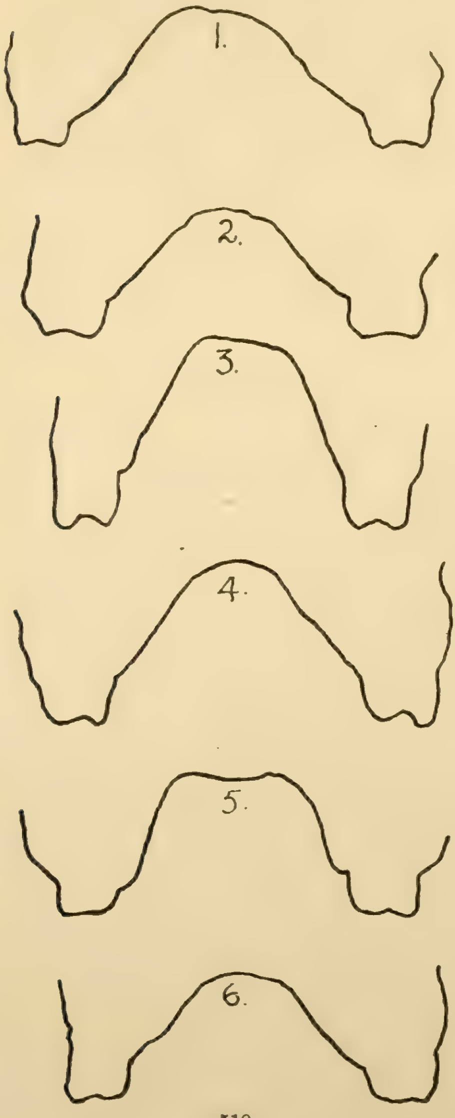


PLATE 23.

Brachycephalic. Colored.

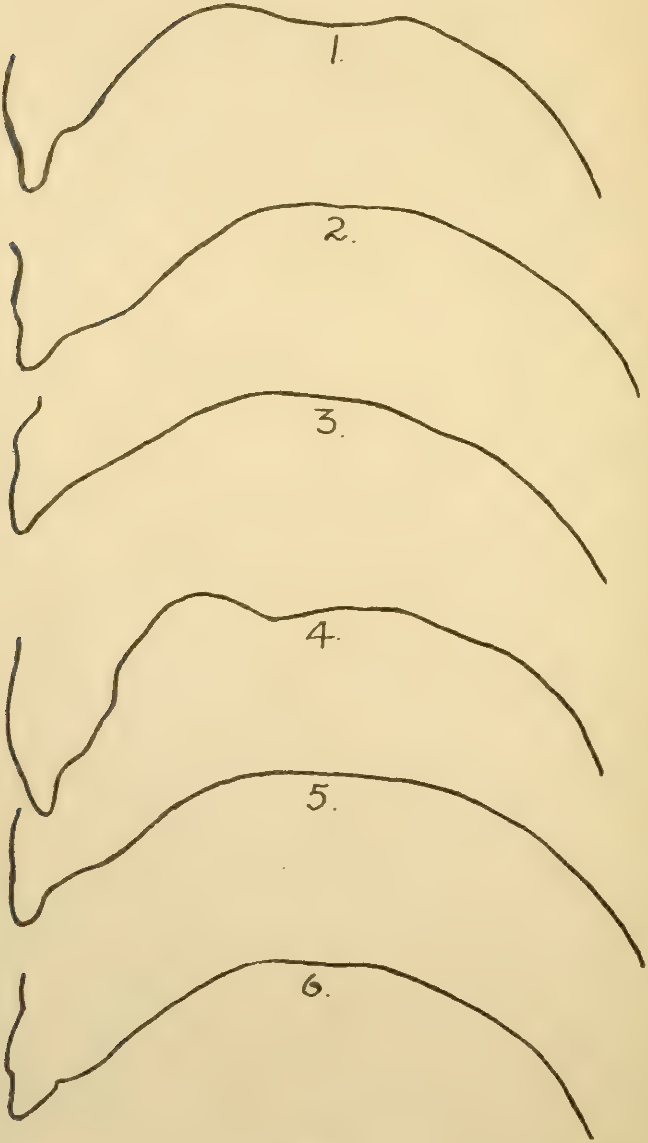


PLATE 24.

Brachycephalic. Colored.

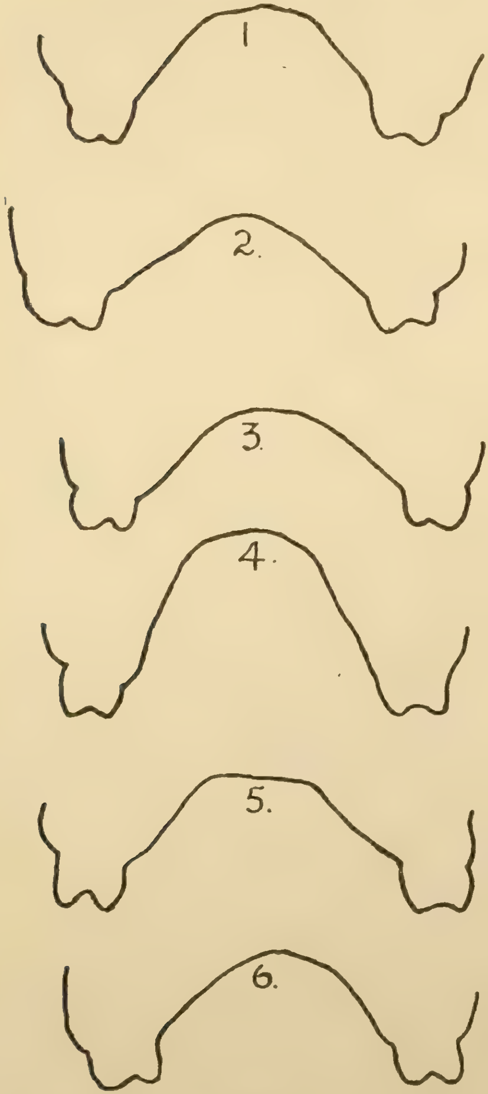


PLATE 25.

Mesocephalic. Colored.

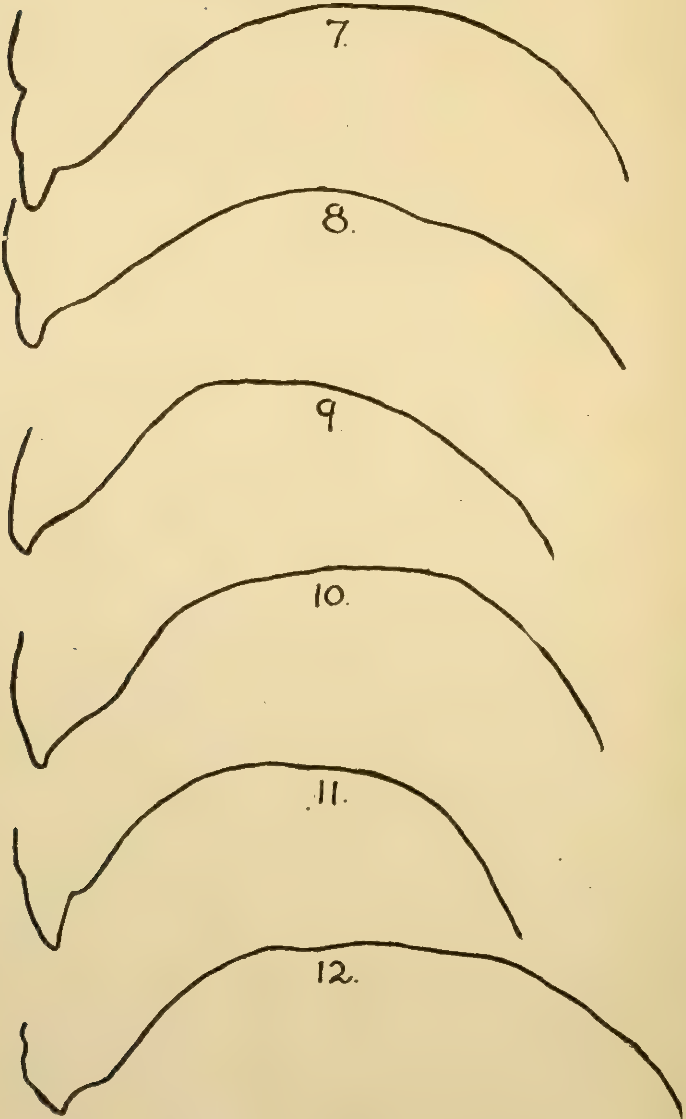


PLATE 26.

Mesocephalic. Colored.

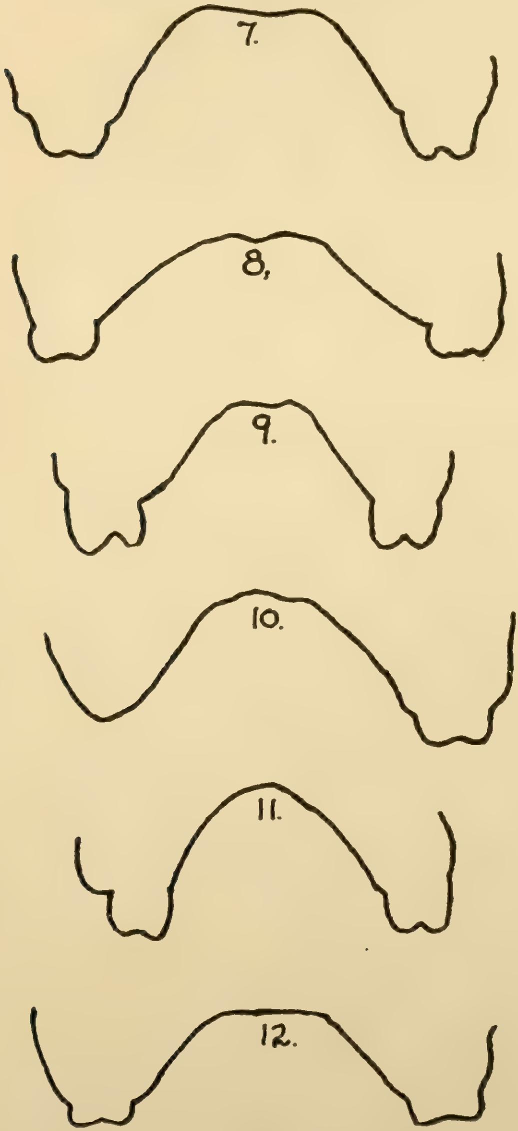


PLATE 27.

Dolichocephalic. Colored.

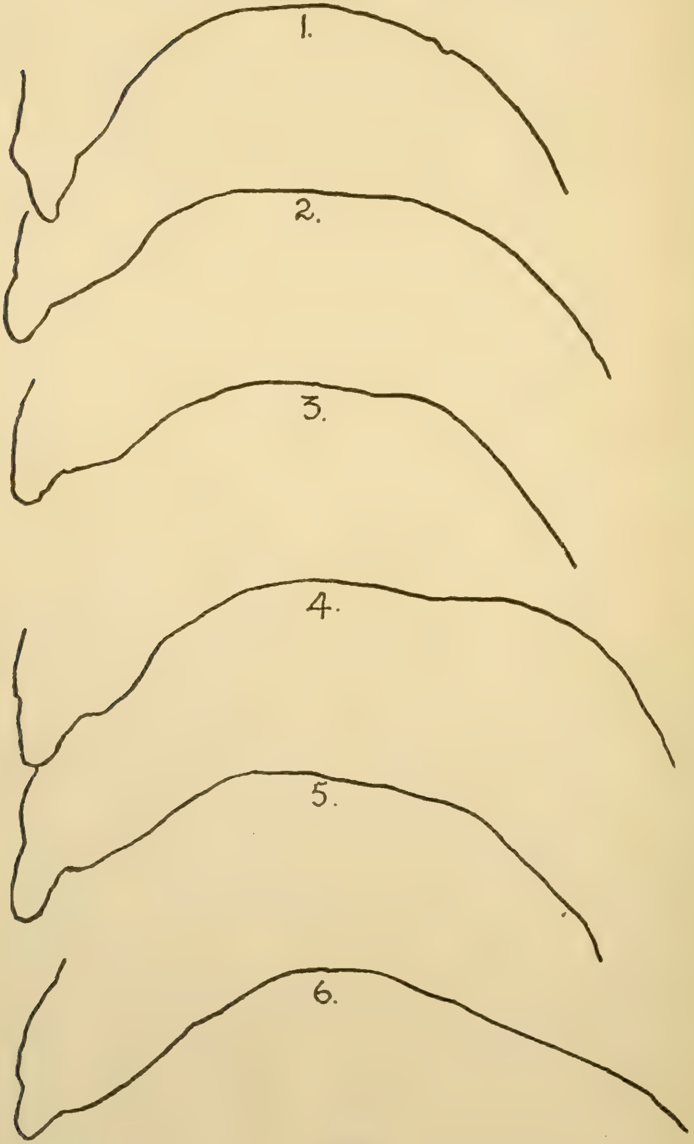


PLATE 28.

Dolichocephalic. Colored.

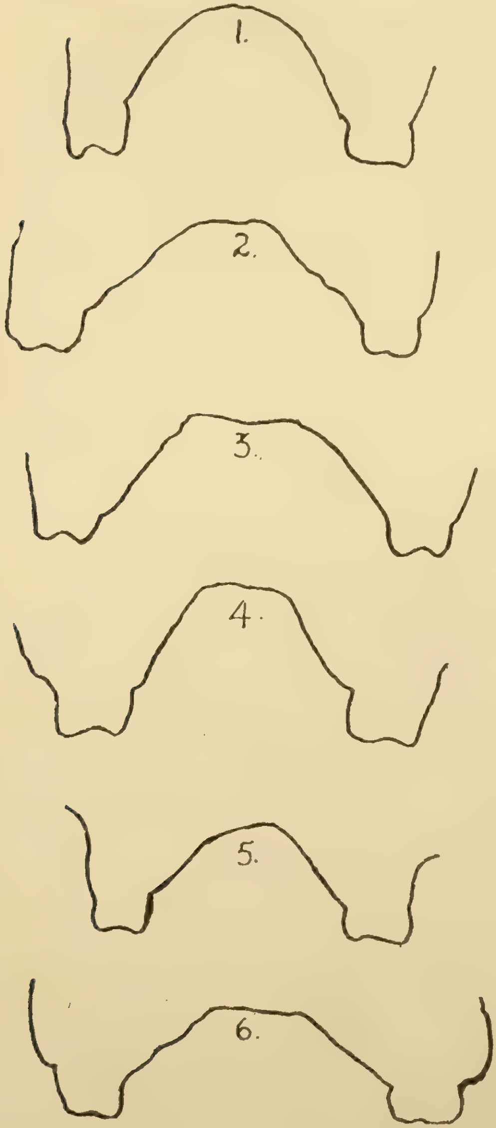


PLATE 29.

V shaped Vault.

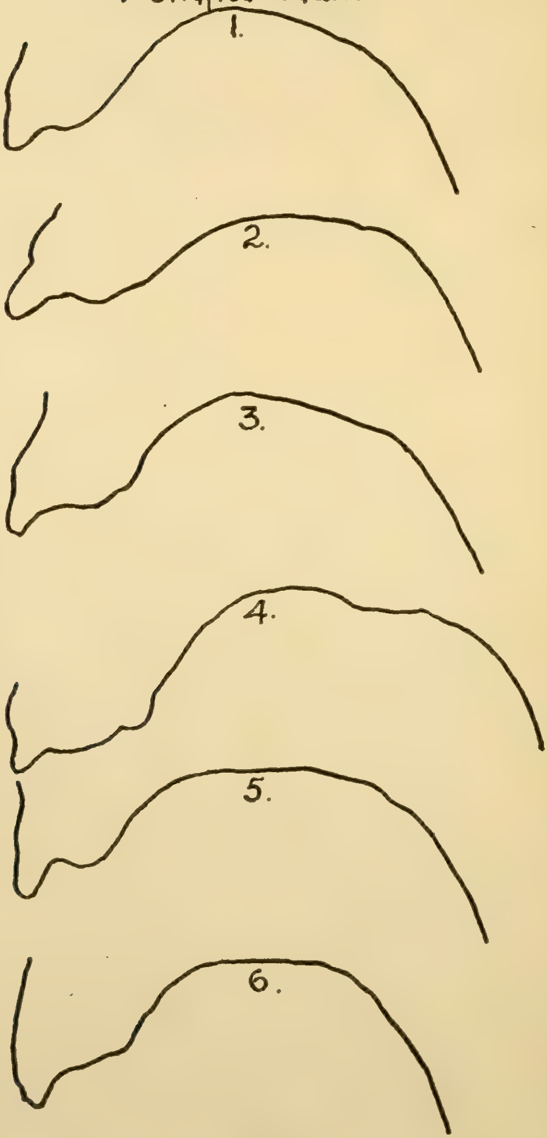


PLATE 30.

V shaped Vault.

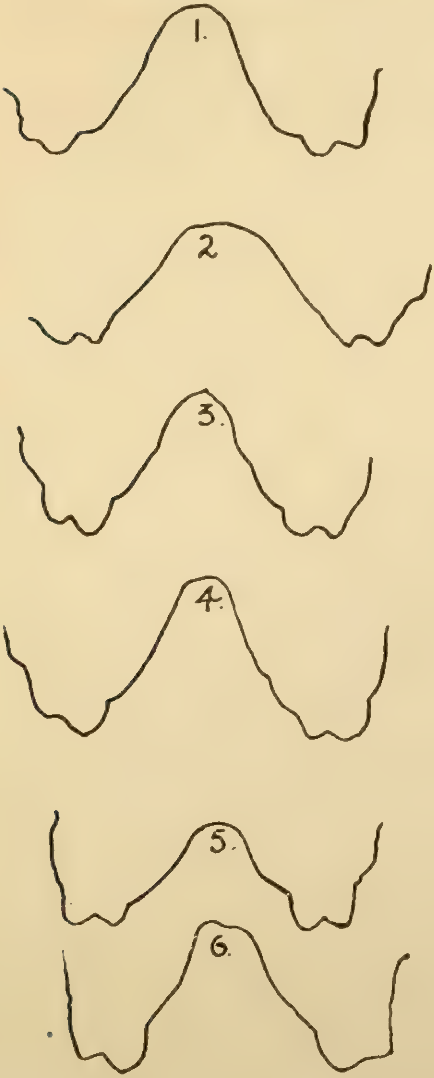


PLATE 31.

Semi V shaped Vault.

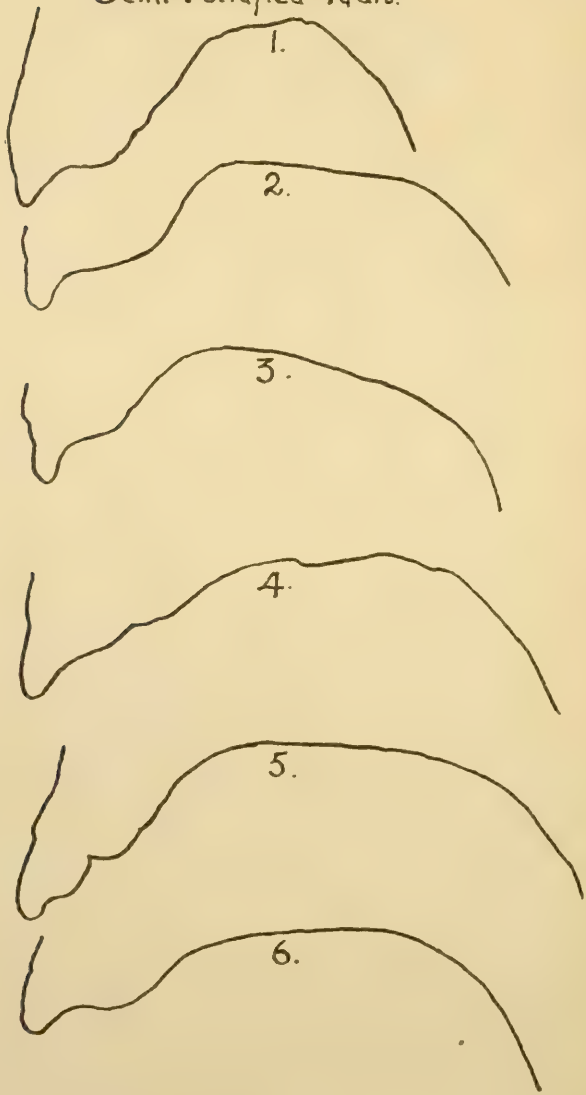


PLATE 32.

Semi V-shaped Vault.

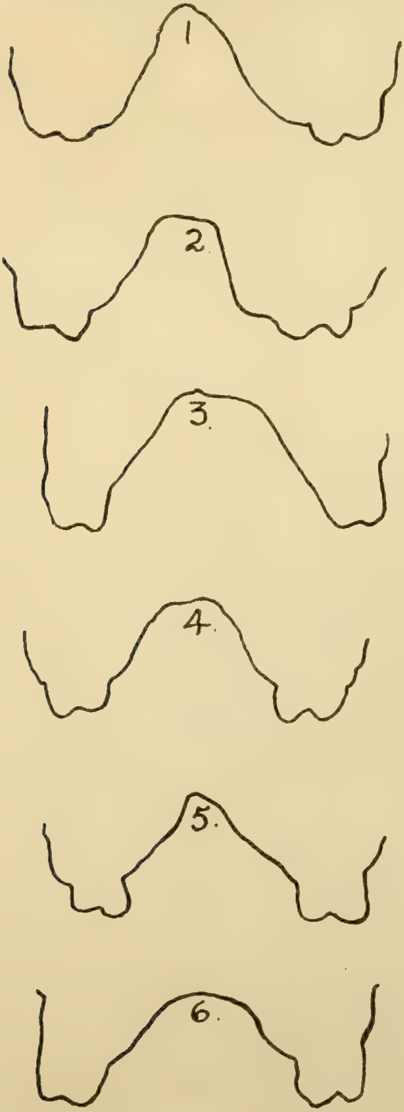


PLATE 33.

Saddle-shaped Vault.

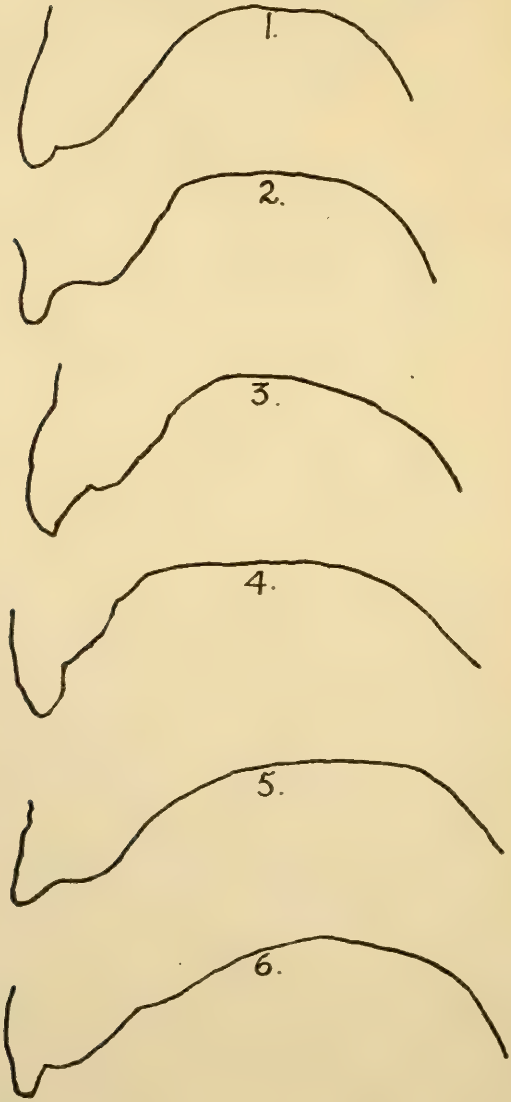


PLATE 34.

Saddle shaped Vault.

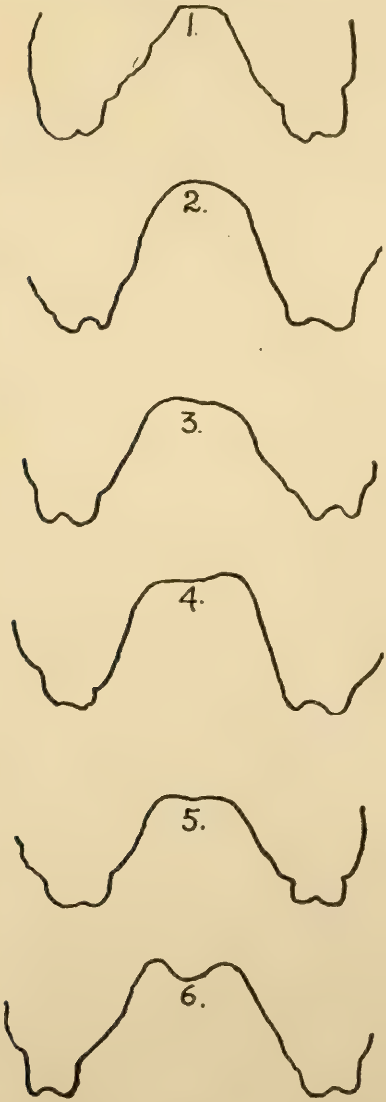


PLATE 35.

Semi-saddle Vault.

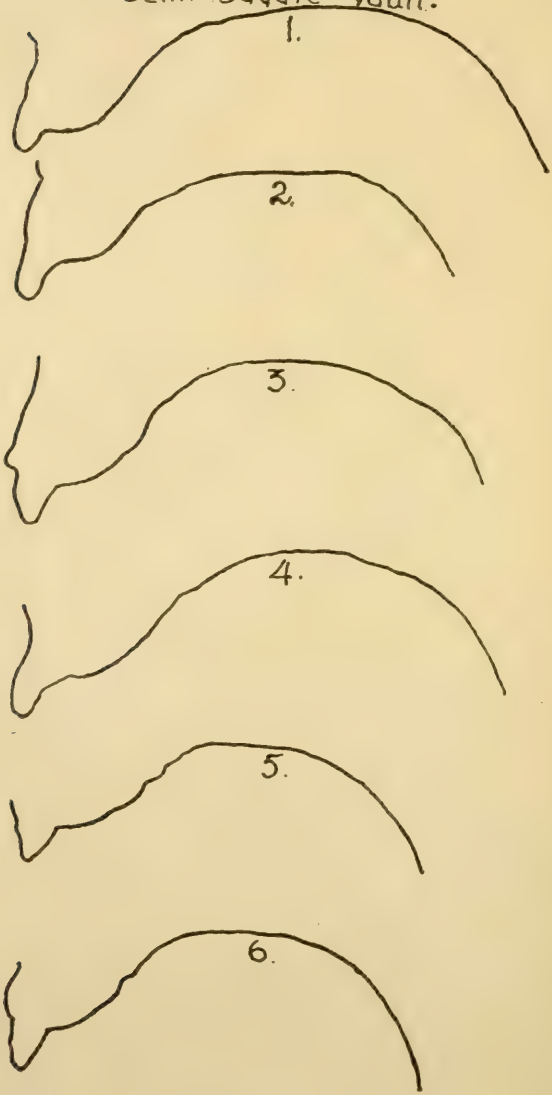
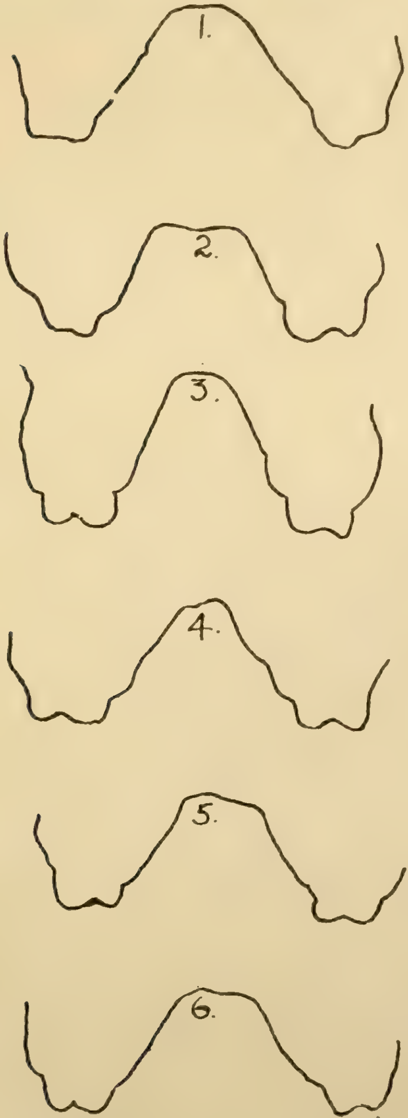


PLATE 36.

Semi-saddle Vault.



EXPLANATION OF PLATES.

Plates 1 to 11 show the shape of the teeth, alveolar process, and vault at the median line.

Plates 2 to 12 show the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar.

Plates 13 and 15 illustrate the shape of the teeth, alveolar process and vault at the median line, of twelve brachycephalic white adults. (For measurements of these cases see pages 486 to 489.)

Plates 14 and 16 illustrate the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar, of twelve brachycephalic white adults.

Plates 17 and 19 show the shape of the teeth, alveolar process and vault at the median line, of twelve mesocephalic white adults.

Plates 18 and 20 show the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of twelve mesocephalic white adults.

Plate 21 shows the shape of the teeth, alveolar process and vault at a median line of six dolichocephalic white adults.

Plate 22 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six dolichocephalic white adults.

Plate 23 shows the shape of the teeth, alveolar process and the vault at the median line of six brachycephalic colored adults.

Plate 24 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the the first permanent molar of six brachycephalic colored adults.

Plate 25 shows the shape of the teeth, alveolar process and vault at the median line of six mesocephalic colored adults.

Plate 26 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six mesocephalic colored adults.

Plate 27 shows the shape of the teeth, alveolar process and vault at the median line of six dolichocephalic colored adults.

Plate 28 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six dolichocephalic colored adults.

Plate 29 illustrates the shape of the teeth, alveolar process and vault at the median line of six V-shaped vaults of white adults.

Plate 30 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of six V-shaped vaults of white adults.

Plate 31 illustrates the shape of the teeth, alveolar process and vault at the median line of six semi-V-shaped vaults of white adults.

Plate 32 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of six semi-V-shaped vaults of white adults.

Plate 33 illustrates the shape of the teeth, alveolar process and vault at the median line of six saddle-shaped vaults of white adults.

Plate 34 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of six saddle-shaped vaults of white adults.

Plate 35 illustrates the shape of the teeth, alveolar process and vault at the median line of six semi-saddle shaped vaults of white adults.

Plate 36 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six semi-saddle vaults of white adults.

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